

JPRS 76187

7 August 1980

China Report

SCIENCE AND TECHNOLOGY

No. 50



FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Indexes to this report (by keyword, author, personal names, title and series) are available from Bell & Howell, Old Mansfield Road, Wooster, Ohio 44691.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

7 August 1980

CHINA REPORT

SCIENCE AND TECHNOLOGY

No. 50

CONTENTS

NATIONAL DEVELOPMENTS

- Twenty Years of Laser Development in China Surveyed
(Ji Zhong, Qun Li; JIGUANG, Jan 80)..... 1

APPLIED SCIENCES

- JS-110 Industrial Minicomputer Described
(ZHONGXIAOXING JISUANJI, Jan 80)..... 19
- Microprogramming for DJS-200/10 Computer Described
(Cai Shijie; ZHONGXIAOXING JISUANJI, Jan 80)..... 21
- Machine Building Ministry Convenes Awards Meeting for
Technological Achievements
(Dong Kegong; GUANGMING RIBAO, 12 Apr 80)..... 40

LIFE SCIENCES

- Rheumatism Successfully Treated With Bee Venom
(TIANJIN RIBAO, 8 Jun 80)..... 42
- 'Qigong' Anesthesia Successful in Thyroid Surgery
(WEN HUI BAO, 19 Jun 80)..... 44
- 'Doctor Computer' Is Brilliant Physician: 'Machine
Diagnosis' Becomes Reality
(WEN HUI BAO, 18 Jun 80)..... 46
- Briefs
Replacing Larynx With Small Intestine..... 48

ABSTRACTS

ELECTRONICS

WUXIANDIAN [RADIO], No 6, 25 Jun 80)..... 49

METALLURGY

JINSHU XUEBAO [ACTA METALLURGICA SINICA; METALLURGICAL JOURNAL], No 3, Sep 78..... 52

NATURAL SCIENCES

BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARIUM NATURALIUM--UNIVERSITATIS PEKINENSIS], No 1, Mar 79, No 2, No 3, 1979..... 60

SHIPBUILDING

ZHONGGUO ZAOCHUAN [JOURNAL OF SHIPBUILDING OF CHINA], No 2, Apr 79, No 3, Aug 79, No 4, Oct 79..... 74

SILICATES AND CERAMICS

GUISUANYAN XUEBAO [JOURNAL OF THE CHINESE SILICATE SOCIETY], No 2, Jun 80..... 90

NATIONAL DEVELOPMENTS

TWENTY YEARS OF LASER DEVELOPMENT IN CHINA SURVEYED

Shanghai JIGUANG [LASER JOURNAL] in Chinese Vol 7, No 1, Jan 80 pp 1-12

[Article by Ji Zhong [4764 6945] and Qun Li [5028 5444]: "A Survey of Twenty Years of Lasers in China (Part 1)"; photographs not reproduced]

[Text] Abstract: This article gives a rough sketch of this country's development of laser science and technology and certain of its results. It first provides the reader with a brief survey, then describes the circumstances surrounding the development of China's first ruby laser. The competing development of various types of lasers during the 1960's is described, along with successive applications of lasers in the 1970's. An urgent call for improvement of basic research is made. A typical laboratory is described. The emerging optoelectronics industry is receiving extensive attention.

It is already fully 20 years since the first ruby laser appeared.

The development of laser science and technology has passed through preliminary basic research and technological preparation and reached the stage of comprehensive development. Internationally, the main indicators of comprehensive development are: the development in depth of laser technology, in which laser radiation has been obtained across the entire electromagnetic spectrum from the far ultraviolet at about 1,000 angstroms to the far infrared at about 400 micrometers and in which great breakthroughs have been made in other laser parameters which are representative of the level of laser technology. For example, neodymium glass laser systems and CO₂ lasers have reached powers above 10^{13} W, supershort-pulse lasers have attained pulse widths of 10^{-13} seconds, and He-Ne lasers have frequency stability down to 10^{-16} . Laser technology has become a powerful research tool for the entire field of science and technology as well as a new direction of technology, with extensive applications that have completely revolutionized optics and solved many problems which had baffled traditional technology. Particularly arresting is the degree to which it has permeated all areas of science, the extent of its influence

and the size of the changes it has wrought, all of which are of inestimable significance. The immense achievements made by laser technology in the last 20 years make it incontrovertible that laser technology is a major invention of the 20th century.

Our own country's pursuit of laser technology began rather late; it was in September 1961 that this country's first ruby laser was successfully developed. Thereafter the new laser technology developed rapidly in this country. In order to strengthen our capabilities and develop a striking force, in 1964 preparations were made in Shanghai for establishment of a specialized laser institute. Thereafter, the various committees at the center as well as local scientific and technological committees set up their own laser technology research units. To date, this country has set up more than 20 laser research institutes, in addition to which it has created plants for laser components and complete devices and production units for the corresponding parts and materials, and has preliminarily created a rather numerous specialized laser technology cadre.

Laser components are the central topic in laser science and technology. To date this country has successfully developed rather many types of laser devices, and in general terms we have all the components which foreign countries have, with 40 types of devices actually in use. This country's neodymium glass laser systems, continuous and high repetition rate YAG lasers, He-Ne lasers, sealed CO₂ molecular lasers, TEA CO₂ molecular lasers and branch selection room temperature CO molecular lasers are all near to or at the world state-of-the-art. The components and materials which are coupled with these devices have gradually gone into series production and commercial production, and have furnished favorable conditions for investigations in laser technology and widespread applications.

The applications of laser technology in this country have their own unique characteristics. Lasers are already in extensive use and have produced a definite effect in micromachining, hole drilling, welding, cutting, measurement, collimation and orientation and precision distance measurement, and more than 40 different laser instruments are already in use in industry. Our country's medical applications of lasers are original, and more than 130 different diseases have been treated using them. A great deal of clinical experience, to an extent uncommon in other countries, has been accumulated. In particular, the development of laser treatment in ophthalmology is already rather mature, and moreover the iris removal operation is in the forefront worldwide. Important applied and basic laser research such as laser-controlled thermonuclear fusion, laser communications and laser isotope separation have also made a definite contribution to this country's socialist construction.

In order to stimulate the development of laser technology, serious attention has always been paid to strengthening academic exchange. In the past 20 years, four nationwide academic report conferences on lasers have been held. In general terms, the theoretical and practical discussions at the first conference solved the question of whether China had the conditions for development of laser research; the second conference reflected the competing development of various types of lasers and revealed a flourishing and variegated situation; the third saw a convergence of various paths, exchange of experience and the formation of a cadre; and the fourth strengthened the foundations and consolidated and improved upon them. In response to the rapid succession of laser applications that have appeared in the 1970's in this country, numerous national and local laser work conferences and laser technical experience exchange conferences have been held. Table 1 summarizes some of these conferences. They have had a certain effect in stimulating thinking, strengthening technological interchange and stimulating the development of laser work in this country. Especially in the last two years, learned collectives such as this country's Laser Division of the Applied Optics Group and laser institutes in many provinces, municipalities and autonomous regions have appeared. Lasers have been included among the country's key research plans as one of the eight leading disciplines and have already become an important branch of this country's modern optics, whose effects are becoming increasingly apparent.

Table 1. National Laser Technology Report and Exchange Meetings

Name	Date	Place	Number of Participants	Number of Reports
Chinese Academy of Sciences First National Quantum Amplification Conference	Jan 1962	Changchun	~ 40	~ 15
Second National Laser Conference	July 1963	Changchun	57	68
Third National Laser Conference	Dec 1964	Shanghai	140	103
Fourth National Laser Technology Report Conference	July 1978	Guangzhou	260	250
Gas Laser Technology Exchange Conference	Nov 1973	Guangzhou	140	46

(Table continued on following page)

Table 1. National Laser Technology Report and Exchange Meetings
(continued)

Name	Date	Place	Number of Participants	Number of Reports
National Medium and Low Power Solid State Laser Technology Ex- change Conference	Sep 1974	Changchun	220	70
Crystal Growth Research Exchange Conference	Oct 1974	Fuzhou	292	143
Symposium on Agricul- tural Applications of Lasers	Dec 1974	Foshan	103	26
National Exchange Con- ference on Key Prob- lems in Investigation and Production of Semiconductor Lasers	Jun 1975	Beijing	102	36
National Laser Energy and Power Comparison Conference and Laser Measurement Experi- ence Exchange and Planning Symposium	June 1975	Shanghai	93	15
National Laser Machin- ing Conference	Nov 1976	Liuzhou	150	~ 100
National Exchange Con- ference on Laser Ap- plications in Medi- cine and Laser Medical Equipment Technology	June 1977	Wuhan	300	~ 100

An Overview

The Shanghai Institute of Optics and Precision Instruments, Chinese Academy of Sciences, is an important base of this country's research and development. Its creation and development have always been the subject of concern and support from the party and state. When lasers were just developing in

this country as a brand new frontier of science and were manifesting their vitality, with the personal concern of our beloved Premier Zhou the State Committee on Science and Technology and the State Economic Committee made a timely decision to set up this institute. In 1973, when Premier Zhou attended the Tenth Party Congress in spite of serious illness, he personally inquired of Comrade Gan Fuxi [1626 4395 3588] about work in lasers, and gave the weighty and foresighted directive that "we must develop and use lasers." For over a decade this institute has continually expanded and grown stronger, and laser technology has made great progress. The number of staff and workers has increased from about 500 to more than 1,400; and the number of laboratories has increased from 7 to 14. The institute has a rather strong technical cadre which includes some famous laser specialists and a group of first-generation laser workers. The personnel are rather young, with their average age under 40, and are full of enthusiasm and ideas. They include the pioneers of this country's first laser, and many of them are key personnel who have scaled the heights of laser science and technology, while even more of them are their able followers. At the National Scientific Congress in 1978 the institute received awards for major scientific achievements from the State Committee on Science and Technology, the Chinese Academy of Sciences and Shanghai City for 16 topics for which it had full responsibility and 13 cooperative topics. Viewing this prospect of numerous skilled personnel and many achievements, we cannot but think of former institute head Wang Daheng's [3769 2192 3801] phrase in a congratulatory telegram on the founding of the institute, to the effect that the unification of the Peking and Changchun contingents is a case of "outstanding personalities well situated."

The scientific research of the Shanghai Institute of Optics and Precision Instruments has development of laser technology as its long-term orientation, but at the same time it is investigating various lasers, laser materials, and parts and other components technologies and studying basic physical problems with regard to lasers, as well as actively developing and disseminating applications of laser technology. All of this work lays stress on basic research and on improvements; and the long range and near term are connected in it and development is integrated, forming an organic unity.

In high-power lasers, at the end of 1961, Deng Ximing [6772 6932 6900] of the Changchun institute independently developed the concept of Q switching, and proposed the use of a mechanically rotated mirror for the purpose. In 1963 another group developed the first high power ruby laser. This group could foresee from their laboratory the further development of this device, but they were already limited by the dimensions and quality of the ruby crystals, and accordingly starting in late 1964 they resolved to make the neodymium glass working medium their main avenue of technological advance. In a situation where there was disagreement abroad regarding the future of these devices, the institute's scientific research personnel

self-reliantly chose this project, which was decisive for rapid development of this country's high power laser technology. In the autumn of 1965, the institute successfully developed this country's first 4-stage traveling wave amplifier neodymium glass high-power laser apparatus, and at the same time they pursued experimental and theoretical research on laser thermonuclear fusion. In 1973, two 10 gigawatt-range high-power neodymium glass laser systems were set up and for the first time a planar target of frozen heavy water and lithium deuteride was irradiated, leading to a fusion reaction and producing almost a thousand neutrons per pulse. In the next year, a large single-beam laser system whose last stage used a large-aperture planar aperture was set up; its output power had been increased to 200 gigawatts, and its pulse width was 2 nanoseconds. This device was used to irradiate a planar target of deuterium-containing polyethylene, increasing the neutron yield to more than 20,000 per pulse. Of course, the neutrons produced by this simple target impact method did not result from thermonuclear fusion and making it more profound, in 1975 the institute set up a 6-beam high power laser apparatus, the largest laser laboratory apparatus that had been set up in the country. In the spring of 1977 they used this apparatus (total output power 200 gigawatts, pulse width 1 nanosecond) to carry out multibeam laser irradiation of a glass shell target, and for the first time they observed laser-induced initial compression of the target material. This indicated that this country's laser thermonuclear fusion research had entered an important developmental stage in step-by-step demonstration of implosion fusion principles. Since 1978, much new progress has been made in basic research. The technological route and experimental projects selected by the institute have their own particular characteristics. The neodymium glass, the xenon lamp, the laser membrane and other optical parts used in the laser were developed by them using domestically-produced materials, and many technological problems involved in the development of laser plasma diagnostics, a high precision target focusing field and plane and spherical fusion targets were also solved through their own research. The extremely high-precision industrial television monitoring and optoelectronic focusing technology used in the vacuum target chambers of the single-beam and six-beam apparatus were developed in late 1973 by the scientific and technical personnel and workers of the institute.

At the same time that they were developing the neodymium glass laser system, a high power transversely excited atmospheric pressure CO₂ laser was also being created. This system consisted of a mode-locked oscillator-preamplifier stage, a large-aperture ultraviolet preionization amplifier stage, and an electron beam controller amplifier stage in series, which will soon be used for experimental research on plasma heating.

In sum, the research on laser thermonuclear fusion is beginning to take shape after 10 years of effort, but to achieve new breakthroughs in this area will require hard effort.

In addition to research on high power laser systems, the institute has also done research on various medium and low power and energy laser systems. These can be summarized in six categories:

--neodymium glass lasers which generally use silicate glasses, including single-pulse devices, multiple pulse devices and supershort pulse devices;

--crystal lasers using ruby, YAG and the like, with the YAG devices including single nanosecond pulse, high repetition rate pulse, supershort pulse, continuous, frequency doubling and tunable types;

--gas lasers whose active media include He-Ne, CO₂, CO, argon, nitrogen, neon, methyl fluoride, methyl alcohol vapor and copper and aluminum vapor; the CO₂ devices have different structures including straight-tube, folded tube, closed circuit and waveguide types;

--semiconductor lasers, including GaAs single and double heterojunction structure devices; research has also been done on integrated optics laser technology;

--pseudomolecular lasers that have produced laser outputs in xenon fluoride, xenon chloride, xenon bromide and argon fluoride;

--dye lasers, with the main working medium being Rhodamine 6G; pumping methods include xenon lamps, YAG laser, nitrogen laser and argon lasers.

Table 2 gives brief details about some of the institute's most representative lasers. It can be seen from the table that some of these lasers are leaders nationwide, some fill national gaps, and some have already reached the worldwide state-of-the-art.

The Shanghai Institute of Optics and Precision Instruments has also done a large quantity of work on many necessary components, materials, processes and component technologies in the process of laser development, and at present it has laid a relatively solid foundation. In the development of laser glasses, it has already produced a relatively complete theoretical and process technology system and has finalized the design of more than 10 glasses whose quality and characteristics are rather good, and which are already in mass production and in extensive use. In addition, it also has developed excellent-quality ruby and YAG crystals, and recently it used a unique process to produce a large sapphire measuring 45 mm long and 52 mm in diameter. In laser components, the institute has skilled techniques and rich experience in developing various types of high energy xenon pulse lamps, high power xenon lamps, high repetition rate xenon pulse lamps, high power continuous-operation krypton lamps and short pulse xenon lamps, of which the high repetition rate xenon pulse lamps and short pulse xenon lamps have characteristics which are

close to the worldwide state-of-the-art. Other components such as high-reflectivity and low-films, semitransparent films, crystal surface protective films and interference filter plates have by and large reached a good quality level. The institute's work in optical computers, optoelectronics, laser parameter testing, optical processing and testing, and precision machinery are all rather noteworthy.

The institute is now actively preparing to produce such laser optical products as a high repetition rate YAG laser, a TEA CO₂ laser, a waveguide CO₂ laser, laser glasses, xenon pulse lamps, laser membranes, optical mirrors, F-P etalons and a planar laser interferometer.

As laser technology has advanced, basic laser research has gradually been strengthened, and certain results have been achieved in various areas:

--considerable research has been done in such areas of laser theory as new resonance cavity structures and cavity wave theory, mode determination, differentiation and separation, mode restrictions in high excitation states, laser dynamic processes, optimal working conditions of lasers, and laser beam modulation and transmission characteristics;

--relatively good progress has been achieved in laser nonlinear optics, such as frequency doubling and high harmonics, four-wave frequency mixing and frequency transfer, parametric oscillation and amplification, and observation and prevention of self-focusing effects;

--as regards strong optical radiation effects, they then studied disruptive effects and the laws of action of strong radiation on various transparent media, nontransparent media and metals;

--in laser plasma physics, they have studied certain principles of the interaction of high power laser light and plasmas, and have investigated physical models of laser implosions.

This specialized research institute, which is in step with the historical process of laser development, gives an epitome of the development of this country's laser work, but it is not the whole picture. Accordingly, the broad mass of this institute's scientific and technical personnel are also active participants in domestic scientific and technical exchange programs and are exchanging their own experiences and studying others' strong points so as to advance their work. Particularly in the last few years, international contacts have become much more frequent, and statistics indicate that since 1972 the institute has received more than 90 groups of visitors from 20 countries, a total of more than 200 person-visits, including many internationally renowned laser specialists who have exchanged experience with the institute's scientific and technical personnel and some of whom have also done short-term work at the institute. In this manner the institute's intellectual atmosphere becomes even more lively.

Table 2. Some Medium and Low Power Lasers Developed by the Shanghai Institute of Optical and Precision Instruments

1. High Repetition Rate YAG Laser (early 1976-August 1976)

Filter external to rod, fluid circulation cooling, two rods in series, multiple reflection rotating mirror Q switching, water-cooled argon pulse lamp pumping. Output 100 MW, pulse width 6 ns, repetition rate 100 sec^{-1} , divergence angle 8 milliradians, continuous operation 100 min, cumulative life 50 hours, comparable with foreign state-of-the-art at the time.

2. YAG Continuous High Power Laser (early 1978-early 1979)

Two rods in series, ground end surfaces, selective optimal mode matching (standard product). Output power 150-200 W, dispersion angle 10-15 mrad, total efficiency 1.3 percent, operating life (one change of krypton lamp) 50 hours.

3. YAG Mode-locked Dye Laser (1976-early 1979)

Semiresonant focused cavity, single transverse mode operation, pentamethylidene (wujia chuan 0063 3946 1557) dye mode locking. Output pulses 20-200 picoseconds, single pulse energy 1 millijoule, single pulse probability over 90 percent, Gaussian space, time and frequency distributions, energy stability better than 80 percent, an advanced domestic product.

4. High Energy Frequency Doubling YAG Laser (1978-September 1979)

One-level oscillator, one-level amplifier, KDP frequency doubler. Over 0.1 J output of 0.532-micron green light, pulse width 4 ns, divergence angle 0.5 mrad, repetition rate 0.5 sec^{-1} , an advanced domestic product.

5. High Energy Frequency Doubling Solid State Laser (1977-February 1979)

YAG resonator with 3-level Nd glass amplifier, KDP/KD*P frequency doubler. Energy transfer efficiency over 60 percent, power transfer efficiency 79 percent, maximum frequency doubled output 1 J, pulse width $\sim 6 \text{ ns}$, divergence angle less than 0.3 mrad, comparable with foreign state-of-the-art.

6. Neodymium Glass Picosecond Laser (1977-June 1979)

Composed of dye mode locking oscillator, single pulse selector and four-stage amplifier. Output pulse width 10 ps, peak power 10^{10} W , dispersion angle 0.5 mrad, an advanced domestic product. Another mode-locked oscillator had an output pulse width of 5 ps, a peak power of 10^8 W , a divergence angle of 1 mrad, and was close to the foreign state-of-the-art.

7. Cold Electron Beam Controlled CO₂ Laser (1974-October 1975)

Cold cathode electron gun, excitation volume 8 liters (1.7 m long), working medium at 1.6 atm. Maximum laser energy 430 J, maximum optical energy density 54 J/liter, pulse width 1-3 microseconds, efficiency 10-16 percent, optical energy density near top foreign levels at the time.

8. Hot Electron Beam Controlled CO₂ Laser (early 1974, October 1975)

Hot cathode electron gun, excitation volume 3.7 liters, working medium at 1 atm. Maximum laser energy 240 J, maximum optical energy density 68 J/liter-atmosphere, peak power 50-100 MW, average power 30 MW, efficiency 10 percent; optical energy density near top foreign levels at the time.

9. JD-1 Triple Folded CO₂ Laser (March-December 1975)

Formed of three water-cooled discharge tubes folded in a plane, used multiple-mirror cavity to expand modal volume, cavity length 6.5 meters, integrated with power source and gas supply unit. Continuous output 250 W, continuous operation 300 hours, life 1000 hours, refillable with gas, power reached same level as similar foreign lasers, but was of sealed type, economical operation.

10. JD-2 Six-fold CO₂ Laser (March 1975-December 1976)

Consisted of six water-cooled discharge tubes folded in column shape, cavity length 12.5 meters, integrated with power source, added gas supply unit. Continuous output 500 W, continuous operation, provided with gas cylinder, could be used sealed, economical operation.

11. Transverse Flow Circulating CO₂ Laser (August 1977-October 1979)

Consists of discharge chamber, blower, heat exchanger and circulating passage, single pass plano-concave cavity, cavity length 1.25 m, excitation length 86 cm. Maximum output 2.9 kW, equivalent to similar U. S. devices surpassed Japanese levels, was this country's first successfully operated, highest-power kw-range transverse flow closed cycle CO₂ laser.

12. Waveguide CO₂ Laser (April 1978-March 1979)

Pyrex glass used as a dielectric waveguide discharge tube, diameter 1.5 mm, length 130 mm, interior cavity type flat-plate cavity. Output power 2 W, mode type EH₁₁, unit excitation length output power 0.15 W/cm, unit excitation volume output power 9.2 W/cm³, continuous operation, close to international state-of-the-art.

13. CO₂ Branch Selection Laser (April 1975-November 1979)

Piezoelectric ceramic self-regulating loop to control cavity length, optical grating coupling selection of different output wavelengths, Invar support, sealed cavity. Some 80 spectral lines selectable between 9.4 and 10.4 microns, output power 10-20 W, single branch TEM₀₀ mode. When operating below 10 W, frequency stability $\sim 10^{-8}$, power stability 2 percent, cumulative life 5,000 hours.

14. CO Branch Selection Laser (October 1978-October 1979)

Optical grating selection used in room temperature CO electrically excited laser, discharge tube length 1.8 meters, internal diameter 12 mm. In early 1979, 60 spectral lines selectable between 5.3 and 5.7 microns, with the maximum single branch power reaching about 6 W, comparable with foreign state-of-the-art at the time; in October 1979, following suitable treatment of electrodes, power was increased to 9 W. Cumulative life, over 350 hours.

15. Fast Discharge Pumped Pseudomolecular Laser (March-November 1978)

Uses parallel plate Blumlein circuit transmission line, operates below 1 atm, single cavity structure. Some 162 spectral lines obtained using XeF; 124 lines more than described abroad.

16. Ultraviolet Preionization High Pressure Pseudomolecular Laser (June-July 1979)

Uses ultraviolet preionization discharge pumping, working pressure 2-3 atm, cylindrical discharge tube, internal cavity structure. Lasing has been obtained out in KrF, ArF, XeCl, ErCl and XeBr; the bromine-containing compounds used in the XeBr series are an original development; 193 nm wavelength obtained with ArF system is shortest oscillation obtained so far in this country.

17. YAG Laser Pumped Dye Laser (1975-early 1978)

Consists of YAG oscillator amplifier, frequency doubling frequency adder, and dye laser; 12 dyes including Rhodamine 6G used. Tunable between 0.28 and 0.7 microns, continuous operation 8 hours, repetition 1-10 sec⁻¹. For Rhodamine G, transfer efficiency in 0.53-0.56 micron range is 30 percent. An advanced domestic product.

18. Xenon Lamp Pumped Dye Laser (November 1978-November 1979)

Repeating pulse xenon lamp pumping of circulating Rhodamine 6G dye. Tunable between 4400 and 7000 Angstroms, bandwidth 0.5 angstroms, repetition frequency 40 sec⁻¹, peak power $\sim 2 \cdot 10^4$ W, average 1 W, pulse width 0.6 microseconds, divergence angle 1-2 mrad.

19. Neodymium Pentaphosphate Small Crystal Laser (1978-January, 1979)

Uses crystals developed by Shandong University, quasi-semiresonant cavity, xenon lamp pumping, longitudinally pumped dye laser. Output power of 30 W in crystal 1 mm thick, single pulse peak power above 300 W, slope quantum efficiency 15 percent, laser threshold 24 microjoules; together with Xi'an Institute No 205 xenon pump components, filled a gap for this country.

20. Neodymium Lithium Tetrphosphate Small Crystal Laser (early 1979-June 1979)

Neodymium lithium tetrphosphate crystal, quasi-semiresonant cavity, developed by this institute, neon lamp used for dye laser longitudinal pumping. Output power 20 W, crystal 0.5 mm thick, single pulse peak power 200 W, slope quantum efficiency 18 percent, laser threshold 15 microjoules, first room temperature laser output in this country.

21. Atomic Copper Vapor Laser (May 1978-August 1979)

Uses copper halides and pure copper vapor as working medium, resonant Blumlein circuit, self-heating and self-excitation, filled with Ne at 20 Torr. Wavelengths of 5106 and 5782 angstroms, pulse width 30 nanoseconds, light output obtained November 1978, filled a domestic gap. Currently average output power 1.8 W, pulse repetition rate 16 kHz.

22. Optically Pumped Far Infrared Laser (1978-June 1979)

CO₂ laser used as pumping source, organic molecular vapor used as medium, Invar support, water-cooled at room temperature. In December 1978, pumping of methyl fluoride vapor obtained a 496 micron laser output, the longest wavelength obtained to that time in this country. In May-June 1979 pumping of methyl alcohol vapor obtained 70 micron and 118 micron output, filling a gap domestically.

Some Attendant Circumstances

Now that laser technology has been developing rapidly for 20 years, we can turn and look at the events surrounding the birth of this country's first laser, a ruby laser. These are very interesting recollections. The photograph below [not reproduced] shows the experimental installation of this country's first ruby laser.

At the end of the 1950's, optical research workers at Changchun led by Chinese optical expert Wang Daheng were investigating various difficulties that had cropped up in their research work, and ultimately involving whether or not they could get over several prohibitions of classical optics: that the brightness of optical sources could only be decreased, not increased; that a light beam tends to disperse rather than the opposite; that images tend to blur and not the reverse; that wavelength can

be increased but not shortened, and the like. At that time, Comrade Gu Qun [7357 0637 0710] proposed a new hypothesis: if an atomic light emitter were placed in a Fabry-Perot interferometer, by lengthening the wavetrain at a certain frequency it should be possible to increase non-chromaticity. At the time, this intellectually lively collective had read Schawlow and Townes' hypotheses on optically stimulated emissions and had begun specific researches in this area. Accordingly, Meiman's [phonetic] achievements accelerated the Changchun optical workers' pace. At that time, young optical specialist Wang Zhijiang [3769 0037 3068], operating in terms of this country's specific situation, proposed on the basis of a series of theoretical analyses and calculations an experimental program keyed to this country's conditions, and led this country's first laser experiment to fruition. Because available ruby crystals were only 30 mm long, he believed that the transfer efficiency achieved by using a spiral xenon lamp for pumping would not be very high, and that accordingly a straight-tube lamp combined with a spherical reflector system would be more reasonable. The first Chinese-style ruby laser resulted from this design approach; see Table 3 for specifics.

Table 3. Main Technical Parameters of First Ruby Laser

Component	Main Parameters
Ruby Rod	Chromium ion concentration 0.04 per cent. Length 30 mm, diameter 5 mm. One end completely silver-plated, opposite silvered with transmission of 15 percent.
Straight-tube xenon pulse lamp	Electrode spacing 40 mm. Interior diameter 8 mm.
Reflector cavity	Two reflective hemispheres, 60 mm radius.
Power supply	Capacitance 2660 microfarads. Voltage 350-550 V.

This laser was operated for the first time in July 1961, producing fluorescence. After two months' effort, in September of that year, it was observed that at a distance of a few meters a bright spot clearly distinguishable from fluorescence was obtained in the device's output. Next, optoelectronic measurements and oscilloscope traces were used to show a sharp peak effect in the optical signal, and accordingly it was affirmed that a laser output had been achieved. Using an optoelectronic method, a pulse energy of about 0.003 joules was measured. We simply mention that this country's announcement of the success came 2 months earlier than

similar experimental results in the Soviet Union. The events surrounding the gestation and birth of this laser device, in regard to both design thought and the overcoming of various technological difficulties, embodied the spirit of creativity in studies and self-reliance.

If the appearance of the first laser can be said to have been only a first beginning, how should we assess its effect? Here may quote an abstract of a report for the reader:

"Another important direction of development is stimulated radiation, particularly laser radiation. From a laser we can obtain monochromatic coherent radiation in an extremely narrow wave packet, with a strength far surpassing levels of magnitude previously attained. For basic scientific research, this will provide a completely new and keen tool to open up a new world in atomic and molecular physics and will create entirely new fields of optochemical research and investigation of strong radiation effects. In optics this will constitute a branch of strong radiation science. Laser radiation not only affects basic science, but will also open broad vistas in engineering technology and in the location, detection and tracking of long-range aircraft, and will offer new possibilities in space communications. Accordingly, the birth and development of laser technology may within ten years produce an extensive effect in science and technology and create new and sophisticated technology."

This was the assessment of the new laser field given in this country's Draft Outline Nationwide Scientific Plan for 1963-1972; when we consider its significance today, it still gives good guidance.

Competing Developments

The appearance of the Chinese-style ruby laser opened the door for the development of this country's laser technology, and thereafter all manner of lasers appeared in quick succession. Here we will merely enumerate some circumstances of the development of a few of the main types of lasers which are characteristic of the progress of laser technology in this country in the 1960's. According to statistics, the country currently has more than 40 types of lasers; Table 4 lists some of the main laser devices and the dates of their first successful operation.

Table 4. Various Laser Devices and Dates of Their First Successful Operation

Name	Date of First Successful Operation
Ruby laser	September 1961
He-Ne laser	May 1963
Neodymium glass laser	June 1963

(Table continued on following page)

Table 4. Various Laser Devices and Dates of Their First Successful Operation
(continued)

Name	Date of First Successful Operation
GaAs P-N junction laser	December 1963
CaWO ₃ :Nd laser	1964
Pure Xe, He-Xe lasers	1964
CaF ₂ :Dy ²⁺ continuous infrared laser	1964
CO ₂ molecular laser	1965
Argon ion laser	1965
Krypton ion laser	1965
HCl chemical laser	1965
Inorganic liquid laser	1967
YAG laser	1968
GaAs-GaAlAs double heterojunction structure laser	1971
CO ₂ TEA laser	1971
CO ₂ gasdynamic laser	1972
DF, HF gasdynamic chemical laser	1973
N ₂ laser	1973
Iodine atomic laser	1974
Gas-explosion gasdynamic laser	1974
Room temperature continuous-operation double heterojunction structure GaAs laser	1975
Solid state explosion gasdynamic laser	1975
Continuous tunable dye laser	1975
Xenon fluoride pseudomolecular laser	1977
XeBr, XeCl pseudomolecular lasers	1978
Electron beam-pumped XeF pseudomolecular laser	1978
Neodymium pentaphosphate laser	1978
Room temperature CO molecular laser	1978
Room temperature branch selection CO molecular laser	1978
HCN far infrared laser	1978
16-micron CO ₂ laser	1979
Neodymium lithium tetraphosphate laser	1979

The photograph at the right [not reproduced] shows a high energy neodymium glass laser. This country's first neodymium glass laser was the one which produced laser oscillations in May 1963 at the Changchun Institute of Optics and Precision Mechanics; the glass medium was developed by the institute. At the time, Comrade Gan Fuxi used his many years of experience in the investigation of optical glasses to find silicate materials and suitable dopant concentrations, and successfully developed a glass working medium which laid the foundations for the neodymium glass laser system that today has taken preliminary shape. To date, this country's high power neodymium glass laser system has already attained $(2-3) \cdot 10^{11}$ watts [1], and 10^{12} watt devices are currently being installed.

He-Ne lasers are the gas lasers currently in most extensive use in this country. According to statistics, there are 80 different units investigating and producing He-Ne lasers, and many plants among them have set up flow line production. The nationwide annual output of He-Ne laser tubes is about 15,000. The dimensions of the devices in common use are 240 mm and 300 mm. The tubes have a life of a few thousand hours, and some units have used a low melting point glass sealing process [2] to produce components whose life has reached 10,000 hours. They have improved the structure of the laser tubes, decreasing the discharge initiation voltage by a third from that of ordinary tubes [3].

The use of methane-saturated stable absorption He-Ne lasers gives a stability better than $1 \cdot 10^{-11}$ and a repeatability of over $4 \cdot 10^{-11}$, with sampling times of 1 and 10 seconds. In some experiments, the stability and repeatability exceeded 10^{-14} . Using iodine stable absorption devices, with a sampling time of 1 second the stability was $(2-3) \cdot 10^{11}$, and with a sampling time of 10 seconds it was $5 \cdot 10^{-11}$, with a repeatability of $2 \cdot 10^{-10}$ [4].

Only by increasing the quality of He-Ne lasers, and particularly their life, can we give them their full effectiveness in utilization. Between 1975 and 1979, the country specially organized seven technical exchange conferences to carry out comparative measurements of the characteristics of He-Ne lasers and discuss key technical tasks and technical exchange.

The first He-Ne laser, produced in May 1963, is already recorded in the annals of this country's laser development. The output of that device was about 1 milliwatt, and the beam divergence angle was less than 0.00032 milliradians. Two years later, type production of He-Ne lasers was begun and commercial models went on sale, which indicates the speed of their development.

Among gas lasers, the CO₂ gas laser is also a fairly extensively used type. Our country has rather many varieties of CO₂ lasers. Ordinary sealed CO₂ lasers with output power below 500 W can produce a 1-meter

single-mode output of 52 W and can burn continuously for more than 5,000 hours [5].

In 1965 when the development of CO₂ lasers was beginning, research conditions were rather difficult, and even the CO₂ gas used was produced by experimental personnel by heating CaCO₃, followed by a series of experimental processes before they obtained spectrally pure CO₂ gas; of course, later experiments have shown that the purity of the gas is not an important factor, but the course of scientific research is always tortuous, a fact which may be noted by those who come after.

The development of CO₂ gasdynamic lasers was begun in 1971. A combustion device with a flow volume of 10 kg had a continuous output power of 37 kW [6]; a combustion type gasdynamic laser using H₂ + CO + O₂ + N₂ and C₂H₂ + CO + O₂ + N₂ as working media had an output power of 500 J and a laser pulse width of 500 milliseconds [6]. The photograph below [not reproduced] shows a pulsed gas explosion laser. Such solid state explosive compounds as the nitrogen-rich tetranitroglycoluril, RDX, 662 and 7201 were used as media for successful development of a solid state explosive gasdynamic laser which achieved an energy of 8.2 J and whose pulse half-width was 10-40 milliseconds [6]. The development of transverse flow lasers was begun in 1972, and a closed-cycle transverse flow laser with a continuous power output of up to 2 kW has not been developed [7]; the average relative power centimeter of discharge length is 20 W.

In 1971 our country also successfully developed a transverse excitation high pressure laser, called a TEA CO₂ laser for short. Currently the level attained by such lasers is a maximum output energy of 400 J/liter-atm [8]. The pulse width of a mode-locked TEA CO₂ laser is several nanoseconds.

In addition to the abovementioned two gas lasers, this country has also developed argon ion, krypton ion, metal vapor and pseudomolecular gas lasers. These lasers have achieved satisfactory development.

The lasers which appeared early in this country include semiconductor lasers. In December 1963 the Institute of Semiconductors, Chinese Academy of Sciences, successfully developed a device whose working medium was a GaAs p-n junction, producing an experimental sample by the diffusion method in the form of a rectangular body with dimensions of 0.15 x 0.2 x 0.8 mm; the two reflective surfaces of the resonant cavity use the cleavage surfaces, the power supply produces square pulses with a width of 2 microseconds, and the device is cooled, operating at 77° K. When the injection current is very small, the emission strength is isotropic and the spectral line width is very broad, i.e. 170 angstroms; when the injection current is increased, the emission intensity peak wavelength shifts toward shorter wavelengths, and the spectral line width decreases; when the current exceeds 2600 A/cm, the spectral lines narrow to under 10 angstroms. Using a high-resolution grating spectrograph it is possible to see the fine

structure of the emission spectrum; and the strongest coherent radiation wavelengths are in the vicinity of 8400 angstroms, with a line width of 0.5 angstroms.

Currently the semiconductor lasers developed by this country also include single heterojunction structure and double heterojunction structure GaAs lasers, a YAG-pumped diode and a tunable tin-lead telluride semiconductor laser. The photo on the left [not reproduced] shows a double heterojunction structure semiconductor laser and experimental installation. This operated continuously at room temperature for 5,000 hours [9].

BIBLIOGRAPHY

1. Laser Thermonuclear Fusion Research Laboratory, Shanghai Institute of Optics and Precision Mechanics, Chinese Academy of Sciences. Experimental Work on Irradiation of a Microspherical Target With Six Laser Beams," JIGUANG, Vol 5, No 5-6, 1978, 9.
2. "A Method of Using Low Melting Point Glass to Seal a He-Nb Laser Tube," JIGUANG, Vol 6, No 8, 1979, 50; "Low Melting Point Glass Sealing Techniques for an Optical Window and Laser Cavity Plate," JIGUANG, Vol 6, No 9, 39.
3. A Methane-Saturated Stable Absorption He-Ne Laser," JIGUANG, Vol 5, No 5-6, 1978, 141.
4. "Investigation of the Characteristics of an Iodine Saturated Stable Absorption Laser," JIGUANG, Vol 5, No 5-6, 1978, 142.
5. "The Effect of the Electrodes and Gas Components on Life and Other Parameters of a CO₂ Gas Laser," in "Zhongguo guangxue xuehui chengli dahui-Xueshu baogao zhengwen zheyao huibian [Collected Abstracts of Scientific Reports at Inaugural Meeting of China Optical Society]," 18 November 1979.
6. "A CO₂ Gasdynamic Laser," JIGUANG, Vol 5, No 5-6, 1978, 49.
7. "Obtaining A 2 kW Continuous Output With A Transverse Flow CO₂ Laser," JIGUANG, Vol 6, No 8, 1979, 63.
8. "An Electron Beam Controlled Discharge CO₂ Laser," JIGUANG, Vol 5, No 5-6, 1978, 55.
9. "A 500 Hour Room Temperature Continuous GaAs/GaAlAs Double Heterojunction Structure Laser," JIGUANG, Vol 6, No 7, 1979, 44.

JS-110 INDUSTRIAL MINICOMPUTER DESCRIBED

Shenyang ZHONGXIAOXING JISUANJI [MINI-MICRO SYSTEMS] in Chinese No 1, Jan 80 inside back cover

[Text] The JS-110 minicomputer, designed by the Shanghai Regulating Instruments Plant, is used primarily in industrial control, but is also suited for scientific calculations, engineering design and data processing. The machine has overcome some of the shortcomings of the JS-10A (the JS-10A is a computer used rather widely in this country for industrial control of which more than 350 have already been sold), its structure is simple, its capabilities are excellent, it is stable and reliable, and in particular the capability-to-price ratio is very good. After inspection to determine whether it has met the design requirements, it will go into series production in 1980. The price will be about 60,000 yuan.

The JS-110 is a 16-bit machine with an internal storage of 8 Kbyte, expandable to 60 Kbyte. It has an automatic dongxiang [0520 0686] interrupt system. It comes equipped with a basic assembler language. It has immediate stack storage protection provision for power outages; when power is restored it automatically removes the program from the stack and starts operation. The machine also may have magnetic external storage. This operates in the asynchronous question and answer mode.

The JS-110 uses a single address, single accumulator, single bus structure, and the PDP-11 standard interface can be used to connect the mini-frame and peripherals. The machine uses stack techniques, which are well suited to interrupt and subroutine nesting. The control unit employs microprogram design, which simplifies control logic. The machine has two independent timing systems, for the CPU and main storage; their independence makes it easy to adjust the machine. The processor status word contains no priority levels, and in actuality No Process Request NPR has priority over Bus Request BR; the bus and CPU priorities are varied in software, but software cannot change the priorities between NPR and BR.

The processor has only an optoelectronic input interface, so that a user who only needs an optoelectronic device need not acquire a complicated standard interface.

The JS-110 instruction set dispenses with specialized i/O instructions, but uses the instruction set to carry out all operations. Because the addressing for peripheral registers and internal memory is unified, the computer can operate peripheral equipment registers just as it controls its internal store. The instructions used for manipulation of data in internal storage may also effectively manipulate data in peripheral registers.

The computer's main peripherals are: an optoelectronic paper tape reader, a teletypewriter, a high speed punch, a tabulator, a ball-type typewriter, a CRT display, an X-Y plotter and a magnetic tape unit. The power supply uses 220V, 50 Hz municipal power. The mainframe uses a Wugongpin [2477 1562 7340] transformer pulse-frequency, pulse-width controlled switched power source.

The JS-110 can be connected to the peripheral process interface to form the JK-110 system for optimal control.

8480

CSO: 8111/1253

MICROPROGRAMMING FOR DJS-200/10 COMPUTER DESCRIBED

Shenyang ZHONGXIAOXING JISUANJI [MINI-MICRO SYSTEMS] in Chinese No 1, 1980 pp 37-45, 52

[Article by Cai Shijie [5591 1102 2638], Nanjing University: "The Microprogramming Design of the DJS-200/10 Computer"]

[Text] Abstract: This article describes briefly the microprogramming concepts and implementation of the low-level No 10 machine of the Chinese-produced general purpose DJS-200 computer series. Particular attention is devoted to describing how the microcommand word segments are delineated and how the microcommands are set up.

1. Introduction

The DJS-200/10 computer (below simply called the "No 10") is a low-level computer in the DJS-200 general-purpose computer series. As a member of the series, it has upward compatibility with the rest of the series. Accordingly, it must have the completely unified standard DJS-200 series instruction and data format, instruction set, character code, interrupt series, channel interfaces and algorithmic languages. Moreover, as a low-level machine the No 10 must have relatively low economic indices. In order to assure that the capabilities of the very large DJS-200 series instruction set could be implemented in a small-sized computer, we selected the microprogramming approach to its design.

The microprogramming concept was first proposed in 1950 by Professor M.V. Wilkes of the Cambridge University Mathematical Laboratory. It was only in the 1960's, when cheap and stable read-only memory technology became widespread, that this technique came into extensive use. Because of several clear advantages, microprogramming control technology was used in most of the IBM series/360 machines, in all of the IBM 370's and in many other computers.

Microprogramming takes traditional programming concepts and techniques into the computer hardware area. It divides the execution of machine instructions and other functions into some more basic operating procedures, with each "more basic" operation controlled and executed by a control word called a microinstruction word (composed of several micro-commands). These control words are stored in ROM, and during operation they are sequentially read out and executed, thus performing the corresponding machine instruction or other operation. This series of microinstructions is called a microprogram.

Because control storage logic replaces combinational logic, medium and small computers have rather powerful capabilities for relatively low cost.

The microprograms of the No 10 include a total of 1,899 microinstructions. Each microinstruction is expressed by a 64-bit control word which is divided into 14 segments. The microprogram is stored in ROM with a capacity of 3072 x 64 bits.

Before giving a specific introduction to the microprogramming of the No 10, it is necessary that we give a simple description of the No 10's data paths.

Figure 1 is a simple representation of the No 10 machine's main data path structures: the main memory consists of a maximum of 4 units, with a maximum capacity of 64 Kbyte; the combination channel includes a byte multiplex channel and 2 array multiplex channels; the interrupt system has the capability of recording, arranging and responding to 4 levels and 5 classes of interrupts; the operation processing system has a full adder Q and a bus MX with half-word structure (plus 2 additional bits) to carry out data transfer and operations and address transfer and operations; 3 full-word registers A, B and C are used to store and release addresses and data needed in the execution of instructions; an 8-bit register G is used to hold the opcode; five 4-bit counters S_I and S_{II} (which can be combined to form an 8-bit counter S), g_I and g_{II} (which can be combined to form an 8-bit counter g) and J_0 are used for control of the sequence of operations and the like; 15 state indicators T_0-T_{15} record the status and flags of the paths; a 64-byte local store is used as a channel backing memory and buffer register, control register, microprogram unit and general register; the central control console has the unified operations capabilities of the series; in sequential control, the microprogram control unit is the point of origin of all control information for the abovementioned components.

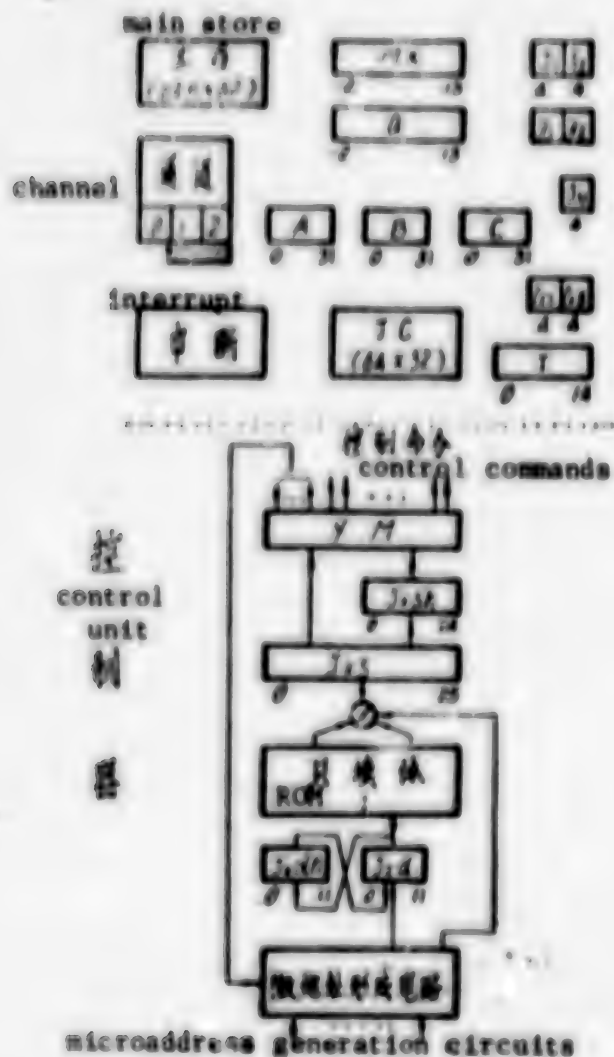


Figure 1. Data paths of the DJS-200/10.

2. Design Philosophy

A. Implementation of System Capabilities

This is the prime objective of the microprogramming of the No 10. Specifically it includes:

- (1) All capabilities of the entire DJS-200 system instruction set (187 instructions);
- (2) The operation capabilities of the DJS-200 series interrupt system (4 levels and 5 classes of interrupt);

(3) The operational capabilities of the No 10 byte multiplex channel and 2 array multiplex channels (other than the data transfer section of the array multiplex channel);

(4) Manual control and manual intervention at the central control panel;

(5) Microdiagnostics.

In reality, other than control of data transfer in the array multiplex channel by means of combinational logic, all other operational capabilities of the No 10 machine are implemented by microprogramming.

B. Simplified Control Structure

In order to simplify control structure, make design easier and facilitate understanding and use by maintenance personnel, the No 10 uses the same microinstruction format for central operations and I/O channel operations; in delineating word segments, direct segment interpretation is primary and indirect segment interpretation is secondary; a relatively straightforward register transfer language form is used to express the micro commands.

C. Lower Costs

In order to decrease costs, the No 10's microprogramming makes use of the following approaches:

(1) Optimized microprogram design

While assuring that all necessary capabilities are made available, the microinstruction word length is shortened as much as possible, the microprogram is refined, and the number of microinstructions is decreased, so as to decrease the amount of ROM required.

(2) Selection of suitable ROM units

In order to assure that the microprogram control unit will be inexpensive, stable and reliable, the No 10 machine uses a hardwired twin-toroid transformer coupling type ROM as its control store, which considerably decreases costs.

D. Guaranteeing a Certain Degree of Expandability

In order to meet the need for expansion of applications, the No 10's microprogram control must assure the possibility of some alteration and expansion (primarily as regards machine instructions).

3. The Read-Only Memory (ROM)

The No 10 machine's microprogram control unit uses a hardwired twin-toroid transformer coupled read-only memory. This has the advantages of low cost, reliable operation and ease of adjustment. Its performance characteristics are as follows:

Word length:	64 bits per word, double word readout
Capacity:	3,072 words
Operating cycle:	less than 600 ns
Fetch time:	less than 300 ns

The ROM address store Jsd is 12 bits long, with the upper 11 bits used to select and read out 2 words with adjoining odd-numbered codes, while the last bit is used to select 1 word for entry in the operand register Jzs.

The twin-toroid storage principle is illustrated in Figure 2. In each pair of cores, the word line passes through the right core to indicate a stored "1" and through the left core to indicate a stored "0." The 64 pairs of cores provide for the storage of 256 words of information. Accordingly, the maximum number of wires passing through a core can be 256.



Figure 2. Transformer-coupled read-only memory

4. Interpretation of the Microinstructions

A. Word Segmentation

The No 10 machine's microcommand word uses segment interpretation. The entire word (64 bits) is divided into 14 segments as shown in Table 1. The meanings of the word segments are as follows:

SY: constant source segment
 QR: full adder input control segment
 QK: full adder operation and yuan/fan [0626 0646] input control segment
 MX: bus input source and output destination selection control segment
 JC: local storage operation control segment
 JS: counter operation control segment
 ZT: set status control segment
 ZA: miscellaneous operation control segment
 GZ: next word address, high bit branch control segment
 DZ: next word address, low bit branch control segment
 AB: next word address, bits A and B branch control segment
 HM: microinstruction Hamming code
 J₀: microaddress parity code
 K: diagnostic flag bit

Table 1. Structure of the DJS-200/10 Microinstruction Word.

HM	JS	ZT	GZ	DZ	AB	J ₀	SY	ZA	JC	QK	MX	QR	K
6	8 7	11 12	17 18 19 20	23 24 25 26	31 32	35 36	43 44	47 48	53 54	59 60	62 63		

It can be seen from this that in principle the microcommand word in the No 10 machine is segmented component by component. This approach has two advantages:

(1) Ease of design

If the words are segmented in terms of components, then the coding of the microinstruction in every segment can satisfy the requirement of mutual exclusiveness. It is favorable for organizing operations performed by combining the various resources into microcommand form. It also simplifies the switch from operational flow to the microinstructions.

(2) Ease of achieving and guaranteeing parallelism of operations

The operations in a single component are generally mutually exclusive. For example, on each occasion an adder can carry out only one operation: computation or transfer, while the local store can only carry out one operation in each case (read or write). Accordingly, the possibility of simultaneous performance of microoperations primarily indicates simultaneity of operations by different components. For example, a full adder and the local store can carry out their various operations simultaneously. When the word is segmented according to components, within one microcommand every component can carry out its operation. This simultaneity increases the flexibility of organization of microinstructions and helps increase the operating efficiency of the microprogram.

As for the question of what size functional component it is best for a word segment to correspond to, this is decided in terms of the following three considerations:

(a) Whether or not use efficiency is sufficiently great.

The ratio of the number of times a segment works in the entire microprogram to the total number of microcommands is called the use efficiency. It is related to the quality and size of the component to which the word segment relates. Table 2 shows the use efficiency of the various word segments in the No 10 machine microinstructions.

Table 2. Use Efficiency of the Segments of the DJS-200/10 Microinstruction Word

segment	7	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
use	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
efficiency	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

(b) Whether or not the required combinational circuits are relatively small.

With word segment interpretation, every segment requires a decoder to decode the instruction. In addition, for compound microinstructions it is also necessary to have a combinational circuit. For example, the microcommand $A_{15-31} \rightarrow Q_x$, $B_{16-31} \rightarrow Q_y$ and the command $A_{15-31} \rightarrow Q_x$, $C_{16-31} \rightarrow Q_y$ both include the move $A_{16-31} \rightarrow Q_x$, and accordingly they are complex microcommands. Neither of them can be used to control that movement. Accordingly, the more compound microcommands there are, especially complex ones, the greater the number of combinational circuits required.

(c) Limitation of the microinstruction word length

In the overall design of the machine there are certain limitations on the microprogram word length. The segmentation must be predicated on this. To decrease word length and also assure control capabilities, it is necessary to expand the range of word segment correspondence to functional components. For example, of the No 10 machine's adder input sources, there are 16 left input sources and 29 right input sources. If we use 2 separate word segments to control it, then we will need $4 + 5 = 9$ bits; but if we use 1 word segment for input control, then because in real operation many combinations of left and right inputs will not be possible, we need only encode 56 simple or compound microinstructions, so that we will only need a 6-bit segment.

The larger the functional component to which the word segment corresponds, the higher the use efficiency of the segment; but the number of composite microcommands encoded will also increase, so that the required combinational circuits will increase in number. Accordingly, to achieve a rational approach we need to seek an optimal compromise which takes account of the abovementioned factors within word-length limitations.

B. Microinstruction Allocation

An n -bit word segment has 2^n different codes and accordingly can define a maximum of 2^n different microcommands (including the no-operation commands). For reasons of compactness, economy and efficiency, every encoded microcommand should have a certain set value (i.e. necessity).

In the No 10 machine, the question of whether or not a microcommand should be encoded is determined in terms of the following three factors:

- (1) The number of times the microcommand will be used when encoded (expressed as N);
- (2) The level of the macrooperation which the microcommand will service (expressed as L). Here the level of the macrooperation (instruction and the like) is determined in terms of the magnitude of its effect on machine capabilities: those with a large effect are at a high level.
- (3) The ratio of the amount of time required when using already encoded microcommands to replace the microcommand in question to the time required if that microcommand is used (expressed as T).

The above three factors must be considered in combination, as they complement each other. Accordingly, we can use the equation $C = NLT$ to describe the coding value of a microcommand. In this way we can determine an efficient choice of microcommands.

Table 3 shows some coded microinstructions in certain word segments; here the coding is octal, and the command symbols are given in register transfer language form.

C. Indirect Coding

If a word segment can only define its code content, this is called direct coding; but if the encoded content must be determined in terms of some code in another segment, this is called indirect coding. Direct coding gives the code in straightforward form, and is easy to translate and convenient to use, while indirect coding has the advantage of saving bits in the control word.

Among the microinstruction word segments for the No 10 machine, the MX and DZ segments use indirect coding, while the others use direct coding.

Table 3. Microcommand Codes in Some Segments of the DJS-200/10 Microinstruction Word

QR	QK	MX	(MX*)	YC	JS	ZT	ZA
00 0 → Q	0 DYS	00 S ₁ → MX	01 S ₁ → A ₁ + T ₁	00 1 → C	00 1 → C	00 1 → C	00 1 → C
01 A ₁ → Q ₁	1 DYS	01 S ₁ → MX	02 S ₁ → A ₁ + T ₁	01 1 → C	01 1 → C	01 1 → C	01 1 → C
04 SY → Q ₁	2 FYS	02 S ₁ → MX	03 S ₁ → A ₁ + T ₁	02 1 → C	02 1 → C	02 1 → C	02 1 → C
A ₁ → Q ₁	3 FYS	03 S ₁ → MX	04 S ₁ → A ₁ + T ₁	03 1 → C	03 1 → C	03 1 → C	03 1 → C
13 A ₁ → Q ₁	4 FYS	04 S ₁ → MX	05 S ₁ → A ₁ + T ₁	04 1 → C	04 1 → C	04 1 → C	04 1 → C
14 A ₁ → Q ₁	5 DYS	05 S ₁ → MX	06 S ₁ → A ₁ + T ₁	05 1 → C	05 1 → C	05 1 → C	05 1 → C
15 B ₁ → Q ₁		06 S ₁ → MX	07 S ₁ → A ₁ + T ₁	06 1 → C	06 1 → C	06 1 → C	06 1 → C
16 B ₁ → Q ₁		07 S ₁ → MX	08 S ₁ → A ₁ + T ₁	07 1 → C	07 1 → C	07 1 → C	07 1 → C
17 C ₁ → Q ₁		08 S ₁ → MX	09 S ₁ → A ₁ + T ₁	08 1 → C	08 1 → C	08 1 → C	08 1 → C
20 C ₁ → Q ₁		09 S ₁ → MX	10 S ₁ → A ₁ + T ₁	09 1 → C	09 1 → C	09 1 → C	09 1 → C
26 A ₁ → Q ₁		10 S ₁ → MX	11 S ₁ → A ₁ + T ₁	10 1 → C	10 1 → C	10 1 → C	10 1 → C
42 A ₁ → Q ₁		11 S ₁ → MX	12 S ₁ → A ₁ + T ₁	11 1 → C	11 1 → C	11 1 → C	11 1 → C
B ₁ → Q ₁		12 S ₁ → MX	13 S ₁ → A ₁ + T ₁	12 1 → C	12 1 → C	12 1 → C	12 1 → C
43 A ₁ → Q ₁		13 S ₁ → MX	14 S ₁ → A ₁ + T ₁	13 1 → C	13 1 → C	13 1 → C	13 1 → C
B ₁ → Q ₁		14 S ₁ → MX	15 S ₁ → A ₁ + T ₁	14 1 → C	14 1 → C	14 1 → C	14 1 → C
46 A ₁ → Q ₁		15 S ₁ → MX	16 S ₁ → A ₁ + T ₁	15 1 → C	15 1 → C	15 1 → C	15 1 → C
B ₁ → Q ₁		16 S ₁ → MX	17 S ₁ → A ₁ + T ₁	16 1 → C	16 1 → C	16 1 → C	16 1 → C
47 A ₁ → Q ₁		17 S ₁ → MX	18 S ₁ → A ₁ + T ₁	17 1 → C	17 1 → C	17 1 → C	17 1 → C
B ₁ → Q ₁		18 S ₁ → MX	19 S ₁ → A ₁ + T ₁	18 1 → C	18 1 → C	18 1 → C	18 1 → C

Note: here
QK ≠ 5 QK = 5

Of the microcommands needed for bus operations in the No 10 machine, half must or can be parallel to full adder DyS (fixed point full carry) instructions (see (MX*) in Table 3), because some of these microcommands cause the bus to accept the output of an operation by adder DyS, while certain other microcommands cause the bus to accept signals from components other than the adder. Of the other half, some can exist at the same time as operation commands for items other than the full adder (not excluding the possibility of their also being compatible with DyS). Thus, when the code 5# (which has the same control effect as the code 0# in DyS) is entered into QK, it is very convenient to implement indirect control of the MX segment via the QK5# code (see MX and (MX*) in Table 3). The indirect result is to cause the 6-bit MX segment to have a capacity of 105 microcommands (which can also be increased to 128) and save 1 bit in the control word, and the only price for this is the code QK5#.

D. The Constant Source Segment Sy

The constant source segment (also called an emitter segment) is a special segment. It provides the constants needed for execution of the

microcommands in question. It does not need a code or interpretation, and its operation permeates most of the components and many operations. Its main effects are:

(1) It sets certain constants in memory; it sets the initial value of the control cycle in counters.

If we use the microcommands $MX*64 \ 0Sy \rightarrow MX_{9-13} \rightarrow A_{25-29}$ and $MX*65 \ 1Sy \rightarrow MX_{9-13} \rightarrow A_{25-29}$ (where $QK = 5$), we can generate certain fixed values in A_{25-29} ; by means of $JS \ 06 \ Sy \rightarrow S_I$ we can initialize the counter; by means of $ZT \ 01 \ Sy \rightarrow T_{0-3}$ we can set the status in the status indicator, and so on. These capabilities are all needed for machine operation.

(2) It participates in operations and supplies correction values.

If we use the command $QR \ 04 \ A_{14-31} \rightarrow QZ_{12-15} \ Sy \rightarrow Qy_{12-15}$, we have the contents of A_{14-31} and Sy perform the operations. When A_{14-31} contains a main storage address, the above operation can add 1 ($Sy = 0001$), 4 ($Sy = 0100$) or 8 ($Sy = 1000$) to that address so as to generate the address of the next byte, the next word or the next double word. In this case Sy provides the correction value.

(3) It participates in storage address generation.

Certain fixed unit addresses in the prefix area of main storage (such as the addresses of the old and new program status words for the 5 types of interrupt, the clock register address and the like) are addressed by means of $MX*64$ and $MX*65$; they are first generated in A and then transferred to the main storage address register for these units. In addition, it can be seen from the microcommand $JC01 \ JC^{01} \rightarrow B$ that Sy determines the 4-bit local storage address (with the 2^{Sy} high-level bits both 1 in this case) referenced by the operation in question. Finally, Sy can also participate in generating the address of the next microinstruction (see below: section on generation of next word address).

However, in a microinstruction Sy can only have a numerical value, and accordingly it generally can only have one use at a time. If several different applications require the same number in Sy , it can service them all simultaneously.

5. Execution of Microcommands

A. Control Method

When the numerical code register in ROM which functions as the microinstruction store receives a microinstruction from storage, it issues by

means of a decoder and a certain combinational circuit various commands encoded in the microinstruction. These commands generally carry out two types of functional control:

(1) Data path operation control. The corresponding word segments are QR, QK, MX, JZ, JS, ZT and ZA.

(2) Microprogram sequencing control. The corresponding segments are GZ, DZ and AB.

As regards the temporal relationships of operation control and sequencing control, there are both series and parallel types (see Figure 3). The No 10 machine uses the parallel type in order to increase efficiency.

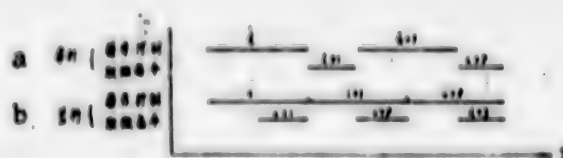


Figure 3. Time chart for sequential and parallel operation

Key: a. Sequential: Operation control
Fetch instruction
b. Parallel: Operation control
Fetch instruction

In addition, the No 10 machine incorporates a numerical code post register to effect partial overlap of the execution of two adjoining microinstructions. During the overlap time, the signal that the earlier microcommand has not completed control is transferred from the numerical register to the numerical code postregister to continue exercising control. This further increases efficiency (see Figure 4).

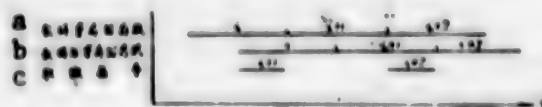


Figure 4. Time chart of parallel, overlapping operation

Key: a. Numerical code register storage
b. Numerical code postregister storage
c. Fetch instruction

B. Timing System

One microinstruction in the No 10 machine can control data flow through a closed cycle of the data path. The operating times of the different components in the cycle are different. In order to assure correct and reliable operation, the No 10 machine incorporates a multiphase clock which provides time control for the operation of the various components. Figure 5 shows 5 main clock pulses in the No 10 machine and their relationship to the various components, i.e. the timing system for the machine. We wish to make clear that adder input and operation control are carried out immediately after interpretation and do not depend on a pulse.

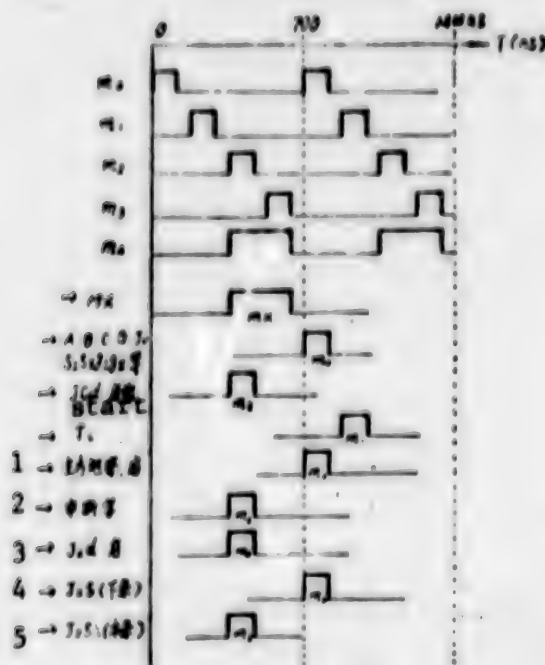


Figure 5. DJS-200/10 timing system

- Key: 1. Main store address entry, start
2. Interrupt word
3. JzD start
4. JzS (second)
5. JzS (main)

C. Method of Generating Next Word Address

By the next word address we mean the address of the next microinstruction. In the microprogram, the next word address is determined by one of the following conditions:

- (1) The opcode
- (2) A special state on some counter (such as all zeros)
- (3) Some status indicator recording data path characteristics
- (4) Some register bit or other data path characteristic

In these cases there is a branch. The microprogramming of the No 10 machine has many branches: 421 2-fold, 35 3-fold, 22 4-fold, 3 6-fold 1 9-fold, 16 16-fold and 1 32-fold. In order to specify the control of the next word correctly, the No 10 machine's microcommands incorporate the GZ, DZ and ZB segments.

The GZ segment controls the information of bits 0-5 of the next word address (called the high-level bits), the DZ segment controls the formation of bits 6-9 (the low-level bits), and the AB segment controls the generation of the 10th (A) and the 11th (B) bits. The GZ segment also exercises direct control over the DZ segment in the manner shown in Figure 6.

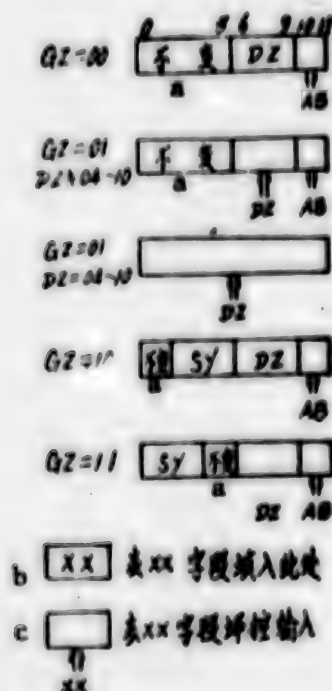


Figure 6. Control method in segment GZ

- Key:
- a. unchanged
 - b. Indicates segment XX entered here
 - c. Indicates xx segment translation control input

The DZ code definitions used when the DZ segment is performing the function of decoding controller are shown in Table 4.

Table 4. Some Code Microcommands in Segment DZ

00	$U_1 \rightarrow Jrd_{1,1}$
01	$U_2 \rightarrow Jrd_{1,1}$
03	$T_{1,1} \rightarrow Jrd_{1,1}$
04	$C_{1,1} \rightarrow Jrd_{1,1}$
05	$D_{0,1} \rightarrow Jrd_{1,1}$
07	$J_{1,1} \rightarrow Jrd_{1,1}$

Table 5 shows some of the microinstructions in the AB segment. In each command symbol, the part before the comma represents the A bit and the part after the comma the B bit.

Table 5. Some Microcommands in Segment AB

00 0, 0	38 $T_{1,1}$	T_1
01 0, 1	44 1,	$T_{1,1}$
02 1, 0	45 0,	$T_{1,1}$
03 1, 1	71 $g=0,$	0
04 $T_{1,1}$	76 0,	$\Sigma_{1,1}$
12 $T_{1,1}$	113 1,	$\Sigma_{1,1}$
22 $T_{1,1}$	120 0,	J_1
24 $T_{1,1}$	147 1,	$H_{1,1} = 0000$

D. Address Forcing Method

The procedure described above is the normal sequential control method. This normal sequence is required during execution of commands or other functions.

In actual machine operation, the normal microcommand sequence often may be broken by the occurrence of some event, for example the discovery of a first or second level interrupt, when it is necessary to call the corresponding microprogram; when the I/O equipment needs to use the relevant data paths of the CPU to exchange data with the memory; when the operator 'intervention button has been pressed on the control panel to call the intervention microprogram and the like. The time at which these events will occur cannot be predicted, and accordingly they cannot be handled by means of normal sequential control. The No 10 machine uses the forced fixed address method to call the microprogram which handles these events. The fixed addresses are as follows:

(1) First level interrupt entry	24-00-00	(010 100 0000 00)
(2) Second level interrupt entry	24-00-10	(010 100 0000 10)
(3) Channel break-in entry	32-00-00	(011 010 0000 00)
(4) System dump	30-00-00	(011 000 0000 00)
(5) Powerup dump	31-00-00	(011 001 0000 00)
(6) Read microinstruction and start from beginning	26-00-00	(010 110 0000 00)

Because channel break-in is a microinterrupt, when forcing to that entry address, the interrupted microcommand address must be entered in J_{zdh} , and when the break-in operation is completed, by means of the microcommand $DZ07 J_{zdh} + J_{zd0-11}$ (with GZ doing the corresponding steps) the breakout is implemented assuring that the original microprogram will be completely performed.

E. Microprogram Main Memory Reference

In the No 10 machine, main memory has a halfword structure. When connected to an odd-numbered location, the main memory acts in mode 1, i.e. the adjoining even and odd coded halfwords are combined to form a word; when connected to an even location, the main memory acts in mode 2, i.e. it forms a word from the two halfwords in the positions which the two cells have in common. In method 1, one memory reference consists of two memory cycles; in method 2, one memory reference consists of one memory cycle. In order to prevent the microprogram from having two different memory reference cycles, the response method is used to link the operation of the central processor and the memory: when the central processor (microprogram) enables the memory, it executes the microinstruction and temporarily stops operation, until it receives the memory response signal (at this time, regardless of which type of memory reference is made, there is an additional write or refresh cycle), after which the central processor is enabled to continue executing the microprogram.

Thus in format, three microcommands all correspond to one memory reference, regardless of whether it is type 1 or type 2.

6. Putting Together the Microprogram

First a flowchart must be made up on the basis of the operations required for machine instructions or other functions, then the branches, cycles and the like of the microprogram design are used, following the specified microinstruction format and coding, to draw up an actual program.

The No 10 machine's microprogram is composed of 5 parts: the instruction microprogram (1,234 microinstructions), the interrupt microprogram (78 microinstructions), the channel microprogram (340 microinstructions), the control panel microprogram (172 microinstructions) and others (75 microinstructions). Below we introduce only the composition of the instruction microprograms.

A. Structure of the Instruction Microprogram

Figure 7 shows the structure of the No 10 machine's instruction microprogram. The instruction microprogram is divided into two major parts: common operations and instruction suboperations. The common operation part fetches the instruction, corrects the instruction address and the computation operand address, fetches the opcode and does some other preparatory work for specific execution of the instruction. Because different types of instructions have different address computation rules, the address computation is done following the branch by category. In each branch, after the address computation is completed and the opcode is fetched, a branch is made to each instruction's suboperation microroutine. The suboperation microroutine for each instruction performs the specified operations on the basis of preparatory work done by the common operation part, then returns to the common operation microroutine and begins the task of executing the next instruction.

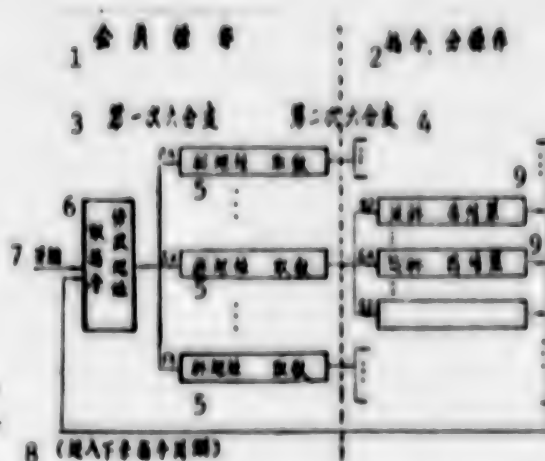


Figure 7. DJS-200/10 Instruction microprogram structure

- | | | |
|------|--------------------------------|---------------------------------------|
| Key: | 1. Common operations | 6. Fetch instruction, correct address |
| | 2. Instruction suboperations | 7. Start |
| | 3. First major branch | 8. Enter next instruction cycle |
| | 4. Second major branch | |
| | 5. Compute address, fetch code | |

B. The Two Major Branches

The common operation microprogram performs two major branches: on the basis of category and on the basis of the instruction.

In defining the instruction set, we provided for convenience in implementing the microprogram, and in the 8-bit opcode we had the high four

bits determine the instruction type and the low four bits determine the instructions within the category. Accordingly, the two major branches in the microprogram can be distinguished simply by the upper and lower four bits. The second type of major branch is required in all categories. Figure 8 shows a series of microcommands implementing the first type of major branch. Here G_1 contains the high four bits of the opcode. Among the 16 microcommand addresses to which the branch can be made, the upper 6 bits are all octal 12, and the lower 4 bits are the high 4 bits of the individual opcodes, while bits 10 and 11 are set at 11.

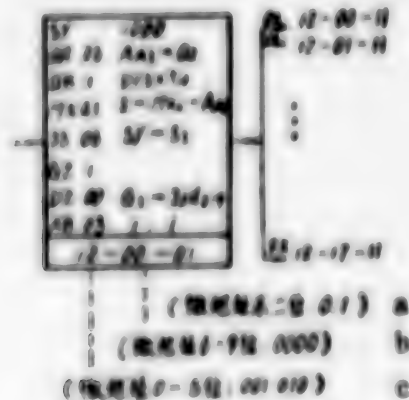


Figure 8. Example of execution of first major branch

Key: a. Last two bits of microaddress: 0, 1
 b. Bits 6-9 of microaddress: 0000
 c. Bits 0-5 of microaddress: 001 010

C. Microprogram Examples

The No 10 machine's microprogram documents include symbolic microprograms and binary microprograms. The former are used in design and testing and the latter in read-only memory.

In order to make the symbolic microprogram straightforward, simple to compose and easy to read, the No 10 machine's symbolic microprograms are organized in a diagram format. Figure 9 shows the suboperation micro-routine for the fixed point add code (opcode 5A).

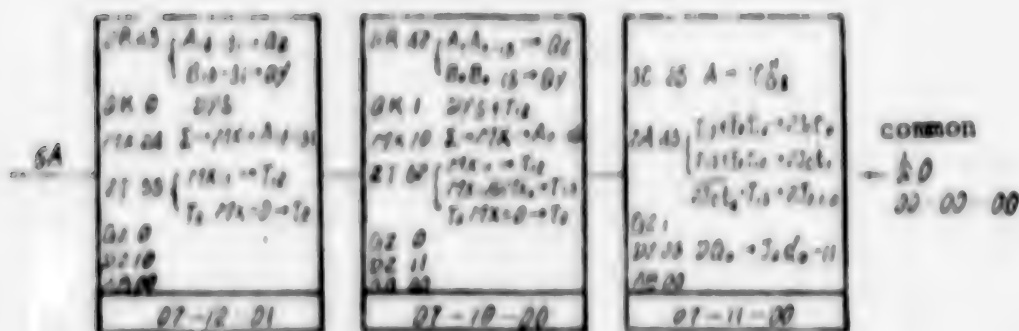
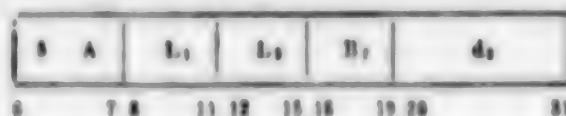


Figure 9. Suboperation microroutine for instruction 5A

The format of instruction 5A is:



The operations in this instruction are: after fixed point addition of the first and second numbers, store them in the third address, general register L_3 , and set the condition code in terms of the answer. The condition codes (2Jct 0,1) are as follows:

Result	Condition code
$= 0$	00
< 0	01
> 0	10
Overflow	11

The common operation microprogram before the second major branch makes the following preparations for operation 5A: first number $\rightarrow A$, second number $\rightarrow B$, $L_3 \rightarrow G_{11}$, $1 \rightarrow T$. Accordingly, the suboperation microroutine for 5A can be executed immediately.

The first microinstruction performs $A_{16-31} + B_{16-31} + A_{16-31}$ and the carry $J_0 \rightarrow MX_{-1} + T_{12}$, records in T_2 whether or not the result is all zeros.

The second microinstruction performs addition of the high half of the extra symbol bits, and adds the carry from the lower half word (A_0) $A_{0-15} + (B_0) B_{0-15} + T_{12} \rightarrow A_{0-15}$, the correct sign of the result $L_{-1} \rightarrow MX_{-1} + T_{12}$, and the overflow discriminator $MX_{-1} \oplus MX_0 \rightarrow T_{13}$.

The third microinstruction stores the result $A + JC_G^{11}$, and sets the condition code $T_{12} + \bar{T}_2 \cdot T_{12} + 2J_{ct0}$, $T_{13} + T_2 \cdot T_{12} + 2J_{ct1}$ and the overflow interrupt $2J_{ct4} \cdot T_{13} + 2J_{zz0}$.

7. Conclusions

A. Assigned Standards Met

The No 10 machine's microprogram design, coupled with that of the other components, met the assigned standard, namely to implement system-compatible capabilities with relatively few facilities and with the same speed. The machine uses a total of 13,730 integrated circuits, located on 736 small boards and 27 large cards. The microprogram has a total of 1,899 microinstructions, and composite microinstructions use about 150 combinational circuits. Mode 2 fixed point addition (subtraction) instruction implementation time is: L-L type, 7.7 microseconds, L-B type 10.5 microseconds.

B. Compact Structure

The No 10 machine uses halfword structure arithmetic and transfer paths, uses a 64-bit (including a 7-bit Hamming code) medium and short control word structure, and as a result of efforts to make improvements in program design, it uses only 1,899 microinstructions to implement a very large instruction set, a complete interrupt system, a complex communication channel and control panel, and reliable checking. Thus the No 10 machine's microprogramming is characterized by structural compactness.

3. Easy To Expand

In various word segments the No 10 machine's microcommands contain a number of empty codes, and the 3,072 x 64 bit ROM only uses up 1,899 x 64 bits, leaving a certain area for expansion of microcommands and microprograms, making it convenient to expand machine capabilities. In particular, each undefined operation code in the instruction set has a corresponding microinstruction, so that expanding the instruction set is very simple. As regards reliability testing, currently there are some checking microprograms such as the main store worst-case checking microprogram, local store checking microprograms and the like. In addition, microinstructions and the relevant hardware for microdiagnostics have been reserved, so that this feature is easy to add.

D. Hamming Code

Because an effort was made to make the twin-toroid magnetic transformer ROM relatively stable and reliable, microcommand Hamming check measures are not very necessary, and can be replaced by a parity check. This saves 5 or 6 bits, making it possible to save 3,072 x (5-6) bits in ROM and making the capability-to-price ratio even better.

APPLIED SCIENCES

MACHINE BUILDING MINISTRY CONVENES AWARDS MEETING FOR TECHNOLOGICAL ACHIEVEMENTS

Peking GUANGMING RIBAO in Chinese 12 Apr 80 p 2

[Report by Dong Kegong (5516 0344 1872) on awards for outstanding technological achievements in the machine building industry]

[Text] The year 1979 saw the most technological achievements. During that year, our machine building industry energetically and thoroughly carried out the guideline of "laying the foundation, achieving higher standards, and striving for the manufacture of complete sets of machinery, and improving services" and the vigorously developed scientific research programs and new products. On the basis of incomplete statistics, a total of 1,391 technological achievements have been made. Of these achievements, 87 of them have either approached or reached the advanced international level. On 5 April, the First Ministry of Machine Building convened a conference to award technological achievements. There were a total of 284 major technological projects that were given awards this time, including 10 first-class awards, 77 second-class awards, and 197 third-class awards. Some of the major technological achievements serving complete sets of large-scale equipment have played an important role in raising the capacity of the machine building industry in manufacturing complete sets of machinery. For example, while developing and manufacturing complete sets of equipment capable of producing 300,000 metric tons of synthetic ammonia and 240,000 metric tons of urea, the units concerned embarked on 56 key research projects, test-produced 35 types of electrical machinery and 233 types of instruments and meters. Among them were items such as large turbine compressors which had never been attempted before in our country. After several years' efforts, the techniques in designing, testing, and manufacturing these products were finally mastered, and the primary economic norms approached the international levels for such products.

Last year the First Ministry of Machine Building also completed a number of major new products, relatively high in standards and in high technical and economic norms. For example, the centrifugal refrigerating unit with a capacity of 2.4 million kilocalories per hour test-produced by the

Chongqing General Machinery Plant is the largest air-conditioning equipment in our nation volume wise. The mass indicators of its thermal insulating rate, unit refrigerating output and unit refrigerating capacity norms have all reached current world standards of similar advanced products. The computerized three-coordinates measuring machine developed and produced by the Shanghai Machine Tool Plant, with a range of 2000 x 1000 x 1000 millimeters could quickly calculate and process data, and automatically take measurements of curvature contours. Its control and measurement capacity approaches the international standard of similar products.

Numerous achievements in the field of basic theoretical research have been made. Last year our country mastered the procedures in large-scale general-purpose structural analyses, raising considerably our standard of production design. The program for the analysis of structural elastoplastic dynamics under the effects of man-made seismic waves or actual seismic waves conducted by the Anti-seismic Research Center of the First Machine Building Ministry provided an advanced and reliable tool for the design of single-storied plant buildings and seismic damage analysis. In addition, it was the first in the country to realize wave-form output. This greatly simplified data processing and increased the speed of operations by 50 times as compared to similar programs.

With respect to the conservation of raw materials and energy, a number of comparatively important scientific and technological achievements were also scored last year. For example, applications have proved that all indicators of the toothed wheel drill bits made from a hard alloy made of coarse crystal granules developed by the Shanghai Materials Institute and the Asian Powder Metallurgy Institute, are not below the standards of imported drill bits. If all of our nation's petroleum drill bits could use this material, the annual cost of drilling footage could be reduced drastically.

Of the projects given first-class awards at this conference, the saw-toothed fin, punch press, and die developed by the Kaifeng Air Separation Equipment Plant were also given the second-class invention award and the easily ground cobaltless high-performance and high-speed steel developed by the Chengdu Tool Institute and the underwater local water displacement semiautomatic welding gun of the Harbin Welding Institute the third-class invention award by the State Commission on Science and Technology.

8174

CSO: 4008

LIFE SCIENCES

RHEUMATISM SUCCESSFULLY TREATED WITH BEE VENOM

Tianjin TIANJIN RIBAO in Chinese 8 Jun 80 p 1

[Text] Reporter Peng Cai [1736 3475] reports: Many victims of rheumatism, who went through a circuit of hospitals in and out of the city, have returned to the Ping District Xiaobailou Public Health Center, being attracted by its reputation and more than 20 years of experience in treating rheumatoid arthritis with bee venom. The rate of effectiveness has reached 86 percent.

Rheumatoid arthritis is a common disease of workers engaged in physical labor. Some young people may also mysteriously contract this disease. It is divided into two types according to the symptoms. In one type, rheumatism invades the joints of the spinal cord and the victim's body is stiff and straight and unable to bend. In the other type, rheumatism invades the limbs to cause the joints of the four limbs to be limited in movement. The joints of the hands and feet swell and gradually become deformed. These victims will ultimately lose the ability to work and live.

In 1958 the old physician of Chinese traditional medicine, Li Yi [2621 3015] of Xiaobailou Public Health Center was inspired by the record of treating diseases with bee venom in MATERIA MEDICA and suggestions from beekeepers. He tried to use live bees to sting to produce venom. In the outpatient clinic, ideal effects were obtained from this treatment for patients suffering joint pains. Later, with the help of the Beijing Pharmaceutical Plant and the support of the Ministry of Public Health, he used the method of electrical needle stimulation to collect bee venom and to make bee venom injection fluid. Beginning in 1960, the drug has been applied clinically in large quantities. After injection, patients all report relief from pain and even relief throughout the body.

The method of integrated Chinese traditional and Western medicine is adopted to analyze the blood and to take x-rays to establish the diagnosis before the Chinese traditional symptomatic technique of treatment is used to determine the type of disease and to select acupuncture points for the injection of bee venom. This treatment produces the fastest effects for severe rheumatoid patients who have not had the disease for very long.

The effects are also noticeable for other forms of the disease, including rheumatoid arthritis, hypertrophic arthritis, neuritis, neuralgia and psoriasis.

In 1970 an 11-year-old girl came down with the peripheral type rheumatoid arthritis. The joints of her limbs were all deformed; her body all curved up and all her vitality was gone. After years of continuous treatment at the public health center, she is able to stand straight. The function of her limbs has been restored and she has learned to cut fabrics and sew. In the same year, a young man was carried to the center on a stretcher. He was 19 years of age and weighed only 35 kg. He had lost all feelings about the external world. Following 3 months of careful treatment at the center, he can now ride a bicycle to the center by himself for treatment. He also regularly comes to the center after work to fetch bee venom to inject others of similar diseases. He says: "This technique saved my life. I want to treat others with the same technique."

In April last year the center added more beds for rheumatoid patients and admitted 13 hospitalized patients. Four of these have been basically cured. At present the hospitalized patients are those coming from the city, as well as Shanxi, Nei Mongol, the northeast, etc.

Just as any other treatment techniques, bee venom injection cannot cure all patients 100 percent. The most valuable thing is that the center enthusiastically accepts all those who come to its doors requesting treatment, and continuously summarizes the experience from the treatment practice in an effort to improve the effect of the technique. As long as there is a need among the masses, they can increase manpower and enlarge the treatment room. They are also prepared to create conditions for going to other organizations where rheumatoid diseases are common and to provide preventive treatment for those who may need it in order to relieve the pain for a greater number of people.

6168

CSO: 4008

LIFE SCIENCES

'QIGONG' ANESTHESIA SUCCESSFUL IN THYROID SURGERY

Shanghai WEN HUI BAO in Chinese 19 Jun 80 p 2

[Text] WEN HUI BAO reporter Jiang Shuzhi [5592 2885 5347] reports that news has come from the Shanghai Institute of Chinese Traditional Medicine concerning preliminary success in the use of qigong [air-power] anesthesia for removing thyroid tumors. Since "hearing it 100 times is not as good as seeing it once," the other day the reporter went to witness surgery using qigong anesthesia. The anesthesia effect was indeed amazing.

In the afternoon of 14 June, the shadowless lamps of the third surgical room of the Shanghai People's Hospital No 8 cast their soft brilliance on a 50-year old woman, laying quietly on the surgical table below. After the physicians and nurses had completed the preparation work, such as disinfecting the skin, etc., a qigong physician was seen coming before the surgical table; he began to apply qigong. He directed his index and middle fingers of his right hand toward the Yintang [acupuncture] point, located between the patient's two eyebrows. He also continuously widened and narrowed the distance between his 2 fingers, but none of his fingers ever touched the patient.

After he applied [air] power in this manner for 2 minutes, he motioned to the chief surgeon, Mao Guanyang [3029 6034 7402] to commence with the operation. Doctor Mao quickly used the surgical knife to make an incision on the skin of the patient's neck, more than 3 cun in length, and fresh red blood immediately gushed out of the opening. The sense of pain is the most sensitive in the skin. While the skin was being cut open, the facial expression of the patient was very calm. She did not even tighten her brow. The qigong anesthesia produced good results.

This qigong physician is Lin Housheng [2651 0624 4164], an assistant researcher at the Shanghai Institute of Chinese Traditional Medicine. He is 41 years of age now. He started to train in qigong when he was 16. In 1977, with the help of concerned comrades at the Shanghai Institute of Nuclear Energy, Chinese Academy of Sciences, an infrared low temperature thermometer was used to test him. It was discovered that after Lin Housheng had gone through the qigong exercise, the instrument received a relatively

high infrared ray reading at 1 meter from the Laogong point of the center of his palm. This experimental result has been verified by repeated tests of such research departments as Beijing Academy of Chinese Traditional Medicine. This data was even imitated by the Beijing Institute of Medical Therapeutic Machines and Qingdao Chinese Traditional Hospital of Shandong Province to produce the infrared ray therapeutical instrument. When Lin Housheng was in the process of using qigong to treat patients, he accidentally discovered that qigong produced analgesic effects. Based upon the hypothesis of qigong anesthesia proposed on the acupuncture anesthesia theory, and with the enthusiastic support of the Shanghai Institute of Chinese Traditional Medicine and the People's Hospital No 8, the first case of surgery under qigong anesthesia was successfully completed on 9 May this year.

This case [observed by the reporter] is the 9th case of removing a thyroid tumor under qigong anesthesia. The surgery proceeded smoothly and the patient remained awake throughout. When the surgery reached the step of separating the tumor in the deep part, the blood vessel forceps produced some pressure on the throat, and the patient tightened her brows a little, but her expression returned to normal after the adenoma, the size of a walnut, was removed. When the incision was sutured, Doctor Mao pulled the loose muscle in the surgical region to show that when the patient did not feel pain the muscles would not be tight.

When the surgery was completed, Doctor Mao told the reporter that qigong anesthesia is applicable for removal of thyroid tumors. The test cases were not selected ones. After surgery, the voice of the patients was good, the recovery fast. Some patients asked to leave the hospital 2-3 days after surgery. Aside from one case of relatively poor anesthesia effect because of lack of energy of the qigong physician at the time, all the remaining of the 9 cases tested reached excellent level of analgesia.

Qigong is one of the valuable medical gifts in China. The preliminary success of qigong anesthesia has created a new way of studying life sciences. At present, related organizations are proceeding with the study of its principle of clinical application and function mechanism.

6248

CSO: 4008

LIFE SCIENCES

'DOCTOR COMPUTER' IS BRILLIANT PHYSICIAN; 'MACHINE DIAGNOSIS' BECOMES REALITY

Shanghai WEN HUI BAO in Chinese 18 Jun 80 p 1

[Text] With the cooperation of Hubei Provincial Computer Central Station and Central South Electrical Power Designing Academy, the Hubei College of Chinese Traditional Medicine obtained results of a preliminary stage in its research on the clinical application of electronic computer in Chinese traditional medicine. It can now use a computer to diagnose the four types of diseases of acute bacterial dysentery, angina pectoris of coronary disease, liver disease, and facial carbuncle. As of now, "examining disease with a machine" has begun to become a reality.

At the provincial certification conference held on 11 June, this "electronic-brain physician" performed before more than 80 delegates coming from Beijing, Hunan, Zhejiang, Guizhou, and points within the province. The 53-year-old Hu Bixia [5170 4310 7209], a victim of angina pectoris of coronary disease came into the diagnostic room. The Chinese traditional physician Wei Xibao [7614 0823 0202] examined the patient's pulse and inquired about his condition, before he fed the "condition of the disease" into the computer and pushed a few buttons. In less than 20 seconds, the typewriter spit out a complete sheet of paper with not only the name, age, sex, date, case history, and diagnosis, but also a prescription of 10 ingredients of Chinese traditional drugs, including *Salvia miltiorrhiza* Bge., *Carthamus tinctorius* L., *Panax ginseng* produced in Shandang of Shanxi Province, *Atractylodes macrocephala* Koidz. etc., and the quantity of each ingredient and the cost of the prescription as well. There was also a final paragraph of a "physician's note" (i.e., items to be given attention by the patient). The speed of this "physician" in examining the patient and the accuracy of the diagnosis won the praise of everyone present.

This technique is called clinical application of the "Chinese traditional medical control theory" of the electronic computer. This is a new science.

Due to the fact that medical literature on Chinese traditional medicine is as extensive as the sea, with numerous branches and schools, there is a certain difficulty in systematic compilation and research. Each Chinese traditional physician is good in one field and deficient in another. In order

to collect the precious clinical experience of the group of old physicians to prevent it from being lost to posterity, it is very necessary to resolve the problem of modernization of Chinese traditional medicine. The clinical application of the electronic computer in Chinese traditional medicine is the use of the control theory to adopt the essence of the mathematical model and computer technology to the systematic research of the overall theoretical system (including Yingyang, the 5 Primary elements, Jingle, pathogenesis, four diagnoses, eight principles, etc.) to search for the relationships between pathogenesis and pathological mechanism, pathological mechanism and external manifestation, and drugs and cure so as to establish some quantitative concepts in these aspects to bring about, step by step, semi-automation or automation.

Beginning in 1977, under the suggestion and guidance of Professor Li Guoping [2621 0948 1627] mathematician of Wuhan University and engineer Song Ruiyu [1345 3843 3768], the Hubei College of Chinese Traditional Medicine launched research in Chinese traditional medicine control theory. In May 1978, the diagnosis and treatment of acute bacterial dysentery with the electronic computer was first realized. Since last June, they have applied the electronic computer to Chinese traditional symptomatic treatment of simple angina pectoris of coronary disease, liver disease, facial carbuncle, etc. Since early this year, a program of multiple diseases has been further developed, including documentations of external signs (symptoms), diagnosis and treatment, Chinese traditional drugs, etc. These source-programs are suitable for the diagnosis and treatment of the aforementioned diseases. In the past 3 years, the computer has made 1,500 diagnoses which corresponded with the ideas of old Chinese traditional physicians at a rate of more than 96 percent. Of the 37 patients who were treated with the computer bacterial dysentery prescription, the rate of effectiveness was 100 percent. Many people have praised the "electronic brain physician" as "an old Chinese traditional physician who has very brilliant medical knowledge."

6248

CSO: 4008

BRIEFS

REPLACING LARYNX WITH SMALL INTESTINE--The surgery of pharyngolaryngeal repair with free segments of intestine after esophageal cancer of the neck region was removed has been successful. The Eye-ear-nose-throat Hospital of the Shanghai First College of Medicine cooperated with Zhongshan Hospital in applying this technique to treat a patient suffering from squamous cancer of the pharyngolarynx and the entrance of the esophagus. In the half a year or so since the operation, the patient has been eating and drinking normally and his condition was found to be good during a recent examination. This type of surgery had not been performed in China before, and only a few such operations have been reported in foreign countries. The recipient of this surgery is a man, 52 years of age. Pharyngolaryngeal and esophageal squamous cancer was diagnosed after hospitalization. Professor Wu Xueyu [0702 1331 1946], chief of the Eye-ear-nose-throat Hospital, Doctor Wang Zhengmin [3769 2973 2404], and Professor Feng Youxian [7458 0649 6343], and Doctors Shi Qun [2457 5028] and Zheng Jiajin [6774 0163 3866] of Zhongshan Hospital organized themselves into a surgical team to perform the operation for the patient on 8 October 1979. The larynx was two-thirds removed and 4 cm of esophagus of the neck region was also removed. At the same time, a segment of the patient's own intestine, with its vein and artery was taken through abdominal incision and transplanted to the missing part of the pharyngolaryngeal-esophageal region. The postoperative condition was satisfactory. The stitches were removed on 17 October and the patient was able to try to eat on 27 October. [Text] [Shanghai WEN HUI BAO in Chinese 19 Jun 80 p 2] 6248

CSO: 4008

AUTHOR: YU Jiale [0151 0857 2867]

OR: None

TITLE: "One Case of Increased Sound Volume for a Radio Receiver"

SOURCE: Beijing WUXIANDIAN [RADIO] in Chinese No 6, 25 Jun 80 p 8

ABSTRACT: A diagram is given to depict the circuit of a common transistor push-pull power amplifier. BC_1 , BC_2 are the original push-pull tubes and BC_3 , BC_4 depicted by dotted lines are the 2 tubes added to increase the output sound volume. The concrete procedure is to weld emitter terminals e of BC_1 , BC_2 to the base terminals b of BC_3 , BC_4 , and weld emitter terminals e of BC_3 , BC_4 to the weld holes of emitter terminals e of the original BC_1 , BC_2 , while collectors c of BC_3 , BC_4 are welded together with respective collectors c of the original BC_1 , BC_2 . This procedure converts the single tube push-pull circuit into a compound tube push-pull circuit. The 2 tubes of the original push-pull circuit are generally symmetrical; therefore, as much as possible the 2 added tubes should also be symmetrical. Testing, matching, or exchanging may be helpful to produce better symmetry and fidelity.

AUTHOR: ZHENG Fengyi [6774 7364 5065]

OR: None

TITLE: "HA1144 Integrated Circuit in Television Receivers"

SOURCE: Beijing WUXIANDIAN [RADIO] in Chinese No 6, 25 Jun 80 pp 13-15

ABSTRACT: The Feiyaol2D4, Kunlun314, Kaige4D14, etc. black and white television sets with integrated circuits currently on the market in China are assembled with 6 integrated circuit chips imported from foreign countries. The journal has received requests from many amateur hobbyists and repair departments to publish articles relating to these chips. This is the first of several articles to be published gradually to introduce the internal circuits and the work principle of these chips which are used in the aforementioned television receivers.

AUTHOR: YI Mingxun [2496 2494 6903]

ORG: None

TITLE: "Basic Characteristics of Integrated Operational Amplifier"

SOURCE: Beijing WUXIANDIAN [RADIO] in Chinese No 6, 25 Jun 80 pp 20-21

ABSTRACT: Initially, operational amplifier is put together with transistor circuits and used mainly in analog-computers to realize such arithmetic functions as addition, multiplication, differentiating, integrating, etc. Soon after the appearance of the digital integrated circuits, integration technique began to be applied in analog circuits to produce integrated operational amplifiers, so that the originally very complicated circuit components are reduced to the size of a transistor, with superior properties, stable reliability, and general applicability. Beyond the original realm of analog computers, it is now a basic amplification component applied extensively in automatic control, metrology, etc. In the past, designers of circuits and systems had to spend considerable efforts and time to design, install, and test amplifier circuits. Now all they need to do is to select and apply integrated operational amplifiers. This paper introduces the basic characteristics of the integrated operational amplifier, which is in fact a high gain D.C. amplifier, from the users' point of view.

AUTHOR: SUN Guoyu [1327 0948 3842]

ORG: Beijing Television Plant

TITLE: "Field-Effect-Transistor On-Circuit Tester"

SOURCE: Beijing WUXIANDIAN [RADIO] in Chinese No 6, 25 Jun 80 pp 26-27, 19

ABSTRACT: This paper introduces the field-effect transistor [FET] on-circuit tester (also called on-line tester). This is to say that there is no need for taking the transistor or component being tested from the circuit board for the purpose of determining its parameters or its being good or bad. The trouble of taking the transistor off and re-welding is avoided. The field-effect transistor tester explained in the paper cannot provide any numerical data other than indicating whether the component is good or bad, however. The tester may also be used to examine current leak. The properties and the work principle of the tester are explained.

AUTHOR: HANG Luneng [1720 6424 1073]

DOI: None

TITLE: "Electronic Sleep-Inducing Instrument"

SOURCE: Beijing WUXIANDIAN [RADIO] in Chinese No 6, 25 Jun 80 pp 31-32

ABSTRACT: Based upon the theory that light and low beeps can cause people to fall asleep, the author and colleagues made an electronic sleep-inducing instrument. The instrument operates on 2 No 5 batteries, with a jack for a small earphone. When the earphone is plugged in, beeps can be heard while a light on the instrument is synchronized with each beep. If the output signal W_2 tube is connected with a low frequency amplifier, the instrument may be used as a metronome to aid the practice of singing, dancing, or playing musical instruments. The structure, parts, and procedure of making the instrument are described.

6168

DOI: 4009

AUTHOR: GUO Jianting [6753 1696 0080]

ORG: Iron-base Superalloy Research Group, Institute of Metal Research, Chinese Academy of Sciences, Shenyang

TITLE: "Effect of Aluminum and Titanium on the Microstructure and Mechanical Properties of an Iron-base Alloy"

SOURCE: Shenyang JINSHU XUEBAO [ACTA METALLURGICA SINICA; METALLURGICAL JOURNAL] In Chinese Vol 14 No 3, Sep 78 pp 227-238

TEXT OF ENGLISH ABSTRACT: In the case of a 35Ni-15Cr type iron-base superalloy, in which phases such as γ' -Ni₃(Al, Ti), M₂₃B₂, TiC, γ -Ti₂SC, β -NiAl, α -Ni₂AlTi, η -Ni₃Ti, σ and Laves may be present, the total amount of aluminum and titanium and the ratio (Ti/Al) in the alloy exerted marked influences upon these phases. It is found that the variation of Al+Ti contents may change the weight fraction, the size and the chemical composition of γ' -phase and γ - γ' mismatch, as well as the microstructure of the alloy after prolonged exposure at 800°C for 500 hours and at 700°C for 5,000 hours. The ratio Ti/Al, however, affected the γ - γ' mismatch and the chemical compositions of γ' -phase, but not the weight fraction and the size of γ' -phase. It was observed that either

[Continuation of JINSHU XUEBAO Vol 14 No 3, Sep 78 pp 227-238]

or Laves phase was present after prolonged exposure at 800°C and 700°C if Al+Ti content of the alloy exceeded 5 or 4 percent respectively. The tensile properties at room temperature and at 650°C, the stress-rupture properties at 750°C, the tensile properties after prolonged exposure at 700°C all showed a change of the mechanical properties of the alloy commensurate with the microstructure mentioned above.

AUTHOR: DENG Zhisheng [6772 2655 3932]
CHEN Chi [7115 4654; deceased]

ORG: Both of the Beijing Institute of Iron and Steel Research

TITLE: "An Investigation of the Crack-Tip Stress and Strain"

SOURCE: Shenyang JINSHU XUEBAO [ACTA METALLURGICA SINICA; METALLURGICAL JOURNAL] in Chinese Vol 14 No 3, Sep 78 pp 239-245

TEXT OF ENGLISH ABSTRACT: With the aid of etching by Fry's reagent and micro-hardness measurements, the crack-tip stress and strain have been investigated. The results obtained may be summarized as follows:

The crack-tip stress increases simultaneously with the angle of bend of the specimen in accord with the relation

$$J = G + \left(\frac{\beta}{\sqrt{3}} + \frac{1}{2} (\sigma_{YY})_A \right) \delta_p$$

derived by us under the linear hardening law:

$$\bar{\sigma} = \beta + \gamma \bar{\epsilon}_p$$

until the critical point is reached:

$$J_c = G_c + \left(\frac{\beta}{\sqrt{3}} + \frac{1}{2} \sigma_F \right) \delta_{p,c}$$

[Continuation of JINSHU XUEBAO Vol 14 No 3, Sep 78 pp 239-245]

demonstrating that at the critical point

$$(\sigma_{YY})_A = \sigma_F .$$

AUTHOR: ZHOU Jing [0719 2417]
CHANG Xin [1603 2500]
GUO Kexin [6753 0668 0207]

ORG: All of the Institute of Metal Research, Chinese Academy of Sciences, Shenyang

TITLE: "Unhealed Porosities and Crystalline Steps in Aluminum Alloy Forgings"

SOURCE: Shenyang JINSHU XUEBAO [ACTA METALLURGICA SINICA; METALLURGICAL JOURNAL] in Chinese Vol 14 No 3, Sep 78 pp 246-252

TEXT OF ENGLISH ABSTRACT: Unhealed porosities and free surface of dendrites with crystalline steps were occasionally observed in aluminum alloy forgings. It was found that the dendrites grow preferentially along $\langle 100 \rangle$ directions and the crystalline steps belong mainly to $\{100\}$ and $\{110\}$ planes.

In the neighborhood of the unhealed porosities the alloy matrix appeared to be embrittled and in certain cases cleavage fracture was observed.

AUTHOR: CHEN Lian [7115 1670]
XU Yongbo [1776 3057 3134]
YIN Wanquan [1438 8001 0356]

ORG: All of the Institute of Metal Research, Chinese Academy of Sciences, Shenyang

TITLE: "Unhealed Porosities and Crystalline Steps in Flakes of Steels"

SOURCE: Shenyang JINSHU XUEBAO [ACTA METALLURGICA SINICA; METALLURGICAL JOURNAL] in Chinese Vol 14 No 3, Sep 78 pp 253-256

TEXT OF ENGLISH ABSTRACT: Dark seams along the rolling direction in certain cases could be observed by means of stereo-microscopic examination of flakes and under higher magnifications in a SEM. These seams were identified as unhealed porosities with crystalline steps and microholes on their inner free surface. The unhealed porosities might be a possible source of flake formation.

AUTHOR: GAO Jianmin [7559 1696 3046]

ORG: Beijing Institute of Metallurgical Equipment Automation

TITLE: "A Theoretical Analysis of Large-Sized Tube Milling by Planetary Skew Rolling"

SOURCE: Shenyang JINSHU XUEBAO [ACTA METALLURGICA SINICA; METALLURGICAL JOURNAL] in Chinese Vol 14 No 3, Sep 78 pp 257-271

TEXT OF ENGLISH ABSTRACT: An attempt has been made to provide a theoretical basis for the large-sized tube milling by planetary skew rolling. Relevant factors, such as the motion scheme between roller and tube, the rolling forces applied, the mode of plastic deformation, the determination of milling pressure, the moment of rolling force, etc., have been calculated with the view of establishing a suitable design.

AUTHOR: YU Guocheng [6735 0948 1004]

ORG: Luoyang Refractory Materials Research Institute

TITLE: "Attack of the Dolomite Lining of Oxygen-Blown Steelmaking Converters by High Phosphorus-Containing Slags"

SOURCE: Shenyang JINSHU XUEBAO [ACTA METALLURGICA SINICA; METALLURGICAL JOURNAL] in Chinese Vol 14 No 3, Sep 78 pp 272-283

TEXT OF ENGLISH ABSTRACT: The very severe attack of the dolomite lining of oxygen-blown steel-making converters by high P_2O_5 -containing slags has been considered on phase relations. In steel-making practice, no difference was observed between slags of high and of low P_2O_5 content in their attack upon MgO in dolomite linings, but upon CaO in the same linings the attack was more severe and the higher the P_2O_5 content of the slag, the greater the attack. Reasons for these are as follows:

1. At $1600^\circ C$ the slag of high P_2O_5 content is a homogeneous liquid or a heterogeneous liquid of high reactivity with CaO , whereas the slag of low P_2O_5 content is a heterogeneous liquid of low reactivity with CaO .
2. At $1600^\circ C$ the slag of high P_2O_5 content sometimes appears to be a two-phase liquid, which attacks CaO severely, whereas the slag of low P_2O_5 content is always a one-phase liquid.

[Continuation of JINSHU XUEBAO Vol 14 No 3, Sep 78 pp 272-283]

3. With slags of high P_2O_5 content, the greater the amount of SiO_2 present, the higher will be its saturation for CaO, thus rendering the attack on CaO more severe. This is not the case, however, with slags of low P_2O_5 content.

The above problem may be remedied by introducing more CaO in slag.

AUTHOR: CHEN Gansheng [7115 3227 3932]
YAO Changchun [1202 1603 2504]
ZHONG Zengyong [0112 1073 1066]

ORG: All of the Beijing Institute of Iron and Steel Research

TITLE: "Effect of σ -Phase on the Mechanical Properties of Certain Nickel-Chromium-Cobalt Base Superalloys"

SOURCE: Shenyang JINSHU XUEBAO [ACTA METALLURGICA SINICA; METALLURGICAL JOURNAL.] in Chinese Vol 14 No 3, Sep 78 pp 284-291

TEXT OF ENGLISH ABSTRACT: An investigation has been carried out on the effect of σ -phase on the mechanical properties of a Ni-Cr-Co based superalloy. Specimens treated to different amounts of σ -phase were compared with the same alloy without such phase. It was found that specimens containing σ -phase of up to 0.7 percent (by volume) showed little deterioration in properties, whereas in the case of those with σ -phase amounting to 2-4 percent, the room temperature tensile strength, impact toughness, endurance, creep and fracture toughness of the alloy were very markedly lowered. Moreover, cracks along the interfaces between the σ -phase grains and the matrix were often observed.

Tensile properties at high temperatures, however, seem to be little affected by such phase. It would appear that σ -phase, being hard and brittle at room temperature, becomes deformable at elevated temperatures.

AUTHOR: ZHOU Yongxin [0719 3057 1823]
HUANG Qingzhu [7806 3237 3796]
CHEN Qiantl [7115 0051 1912]
DENG Dingqing [6772 1353 1987]
PU Shaokang [5543 4801 1660]

ORG: All of the Iron and Steel Research Institute, Wuhan Iron and Steel Company

TITLE: "Effect of Copper on the Recrystallization Texture of Cold-Rolled Low-Carbon Steel Sheets"

SOURCE: Shenyang JINSHU XUEBAO [ACTA METALLURGICA SINICA; METALLURGICAL JOURNAL] in Chinese Vol 14 No 3, Sep 78 pp 292-297

TEXT OF ENGLISH ABSTRACT: The recrystallization texture of cold-rolled low-carbon steel sheets containing copper up to 0.355 percent has been studied by means of X-ray pole density measurement, plastic strain ratio measurement and metallographic etching-pit technique. It is shown that the {111} texture component, which is beneficial to the deep-drawing ability, appears to be enhanced with increasing copper content, especially when the copper content exceeds the limit of solubility. Fine precipitates of δ -Cu phase around dislocation in specimens containing 0.355 percent Cu have been observed by

[Continuation of JINSHU XUEBAO Vol 14 No 3, Sep 78 pp 292-297]

transmission electron microscopy. The presence of such precipitates may be regarded as the cause of the enhancement of the {111} texture component.

AUTHOR: LI Chunzhi [2621 2504 1807]

ORG: None

TITLE: "Matrix Analysis of Rotation Twins"

SOURCE: Shenyang JINSHU XUEBAO [ACTA METALLURGICA SINICA; METALLURGICAL JOURNAL] in Chinese Vol 14 No 3, Sep 78 pp 298-303

TEXT OF ENGLISH ABSTRACT: Two transformation matrices appropriated to describe the rotation of the crystallographic coordinate systems are proposed. The transformation matrices for components of vector rotated about an arbitrary axis by any angle in crystal real space or reciprocal space are derived.

AUTHOR: WANG Renhui [3769 0088 0583]
KANG Lishan [1660 4539 1472]
SUN Tianxi [1327 1131 6932]
WAN Xian [8001 2009]

ORG: WANG and KANG both of Wuhan University; SUN and WAN both of the Iron and Steel Research Institute, Wuhan Iron and Steel Company

TITLE: "Treatment of Extinction Problems in the Calculation of Fundamental Data of Reciprocal Lattice Planes"

SOURCE: Shenyang JINSHU XUEBAO [ACTA METALLURGICA SINICA; METALLURGICAL JOURNAL] in Chinese Vol 14 No 3, Sep 78 pp 304-309

TEXT OF ENGLISH ABSTRACT: A computer program has been given for calculating the fundamental data of reciprocal lattice planes, with special attention paid to the problem of systematic extinctions for phase analysis by electron diffraction methods. Satisfactory results have been obtained in the cases of diamond, spinel as well as hexagonal close-packed structures.

AUTHOR: LIU Fuyou [0491 1381 2589]

ORG: Central Laboratory, Kunming Iron and Steel Works

TITLE: "Surface Enrichment of Residual Elements and Oxidation of Austenite Grain Boundaries"*

SOURCE: Shenyang JINSHU XUEBAO [ACTA METALLURGICA SINICA; METALLURGICAL JOURNAL] in Chinese Vol 14 No 3, Sep 78 pp 310-315

TEXT OF ENGLISH ABSTRACT: The hot shortness mechanism in the temperature range 1050-1250°C of mild steels, containing 0.1-0.4 percent Cu, 0.1-0.4 percent As, 0.01-0.03 percent Sn, has been investigated by means of hot bend tests, optical microscopy, scanning electron microscopy and electron probe. The deleterious effects due to surface enrichment of As and Cu and the oxidation at austenite grain boundaries appear to be the main cause of hot shortness of the material.

* Taking part in some of the analytical and experimental work were: JIN Xuecai [6855 1331 1752], GU Weilin [7357 5898 2651], ZHOU Jianming [0719 1696 2494] and QIU Yajuan [5941 7161 1227].

AUTHOR: LIAO Shantao [1675 1472 3447]

ORG: Department of Mathematics

TITLE: "An Existence Theorem for Periodic Orbits"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARIUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 1, Mar 79 pp 1-20

EXCERPT FROM ENGLISH ABSTRACT: In the study of differentiable dynamical systems, we often meet the question as to whether certain periodic orbits exist. For instance, an Axiom A system of Smale not only requires its non-wandering set Ω having hyperbolicity structure, but also requires its singular points and periodic orbits being dense in Ω . When a closed invariant set Λ already has a hyperbolicity structure, we still need to consider in certain cases the existence of periodic orbits nearby Λ , e.g., Newhouse's generalization of the so-called Anosov lemma.

For some purpose in our future study, we shall prove in the present paper a more general theorem, which asserts the existence of periodic orbits near a quasi-hyperbolic integral arc.

AUTHOR: XU Baolu [6079 1405 7498]
CHEN Jiading [7115 1367 7844]
ZHENG Zhongguo [6774 1813 0948]

ORG: All of the Department of Mathematics

TITLE: "On the Coincident Property of Stochastic Matrices"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARIUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 1, Mar 79 pp 21-47

EXCERPTS FROM ENGLISH ABSTRACT: Let E be an atmost countable set, and $P = (p_{ij}, i, j \in E)$ be a stochastic matrix. Any Markov Chain $(x_n, n \geq 0)$ with transition matrix P is called a P -chain.

Definition. A stochastic matrix P is said to have coincidence property (c.p.) if:

$$IP \left(\sum_{n=1}^{\infty} \{ \omega: x_n = y_n \} / x_0 = i, y_0 = j \right) = 1,$$

where $(x_n, n \geq 0), (y_n, n \geq 0)$ are arbitrary mutually independent P -chains on $(\Omega, F, IP), i, j \in E$.

When does P have c.p.? In this paper, three theorems are derived, and certain more general conditions sufficient for c.p. are obtained. Several examples are given.

AUTHOR: JIANG Boju [1203 0130 7467]

ORG: Department of Mathematics

TITLE: "Estimation of Nielsen Numbers (II)"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARIUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 1, Mar 79 pp 48-57

EXCERPT FROM ENGLISH ABSTRACT: Let X be a compact connected polyhedron, and $f: X \rightarrow X$ a self-mapping of X . It is observed that the group $J(f)$ ($=T(f)$ of [1]) acts on the right on the set of all fixed-point-classes of f , and any two fixed-point-classes equivalent under this action have the same index. This paper looks into the orbit structure of this transformation group, and especially the lengths of the orbits, the knowledge of which would be helpful in the estimation of the Nielsen number $N(f)$ of f .

AUTHOR: SHEN Xiechang [3088 3610 2490]
LOU Yuanren [1236 0337 0088]

ORG: Both of the Department of Mathematics

TITLE: "On the Best Approximation by Rational Functions in the $H_p(P, 1)$ Space"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARIUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 1, Mar 79 pp 58-72

TEXT OF ENGLISH ABSTRACT: In this paper we obtained some theorems of the best approximation in the norm of $H_p(P > 1)$ space by rational functions with preassigned poles in the unit circle of the complex plane. We also proved some converse theorems.

AUTHOR: HAN Nianguo [7281 1819 0948]

ORG: Beijing Observatory, Chinese Academy of Sciences

TITLE: "Two Forms Equivalent to Zorn's Lemma"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARIUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 1, Mar 79 pp 73-74

TEXT OF ENGLISH ABSTRACT: First, we give the following definitions:

Definition 1. Let P be a relation on X (not necessarily partially ordered set). A chain in X is a subset C of X such that, for all $x, y \in C$ we have $(x, y) \in P$ or $(y, x) \in P$.

Definition 2. Let P be a relation (not necessarily partial ordering) on X and $m \in X$. The element m is called quasi-maximal if $x \in X$ and $(m, x) \in P$ implies $(x, m) \in P$.

Second, we prove the following two propositions are equivalent to Zorn's Lemma:

Proposition 1. If P is a relation on X , then there exists a maximal chain in X .

Proposition 2. Let P be a transitive (not necessarily reflexive or antisymmetric) relation on X . If every chain in X has an upper bound in X , then X contains a quasi-maximal element.

Finally we have an example, a shorter proof of Radon-Nikodym theorem by this Proposition 2 than by Zorn's Lemma or by others known.

AUTHOR: YANG Fuqing [2799 5346 3237]
XU Lianfang [1776 5114 5302]
ZHU Huizhen [2612 1979 4176]
ZHONG Cuihao [0112 5488 6275]

ORG: YANG, XU and ZHU all of Beijing University; ZHONG of the Institute of Computing Technology, Beijing University

TITLE: "A Modular Design Method of Operating Systems"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARIUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 1, Mar 79 pp 75-89

TEXT OF ENGLISH ABSTRACT: In this paper is described a new modular design method which consists of decomposing every operating system into three kinds of basic components, i.e., monitors, classes and paths. It not only makes the system structure more morlulged [sic], but also improves its reliability and maintainability. We also give an example which illustrates these basic components, and a way of constituting a whole system from these components.

AUTHOR: WU Huiding [0702 6540 4299]
ZHANG Yuling [1728 3768 3781]
JI Xiaoyang [1323 2556 7122]
YANG Chuncheng [2799 2504 1004]

ORG: WU and ZHANG both of the Department of Geophysics; JI and YANG both of the National Marine Service

TITLE: "An Experiment in Numerical Prediction of Marine Surface Winds"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTIARUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 1, Mar 79 pp 60-68

TEXT OF ENGLISH ABSTRACT: The prediction of marine surface wind was made by use of the boundary layer model that was combined with Beijing University's 5-level NWP model based on the boundary layer resistance laws. The comparison of a 24-hour wind forecast with the ship observations shows a satisfactory agreement.

AUTHOR: BAI Shunliang [4101 7311 5328]
JIN Shanyu [6855 0810 8762]
NING Zongshan [3942 1350 0810]
HE Jinhua [0149 6930 3352]
HAN Yingjian [7281 6601 1696]

ORG: None

TITLE: "Devonian Conodonts and Tentaculitids of Guangxi, Their Zonation and Correlation"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTIARUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 1, Mar 79 pp 99-117

TEXT OF ENGLISH ABSTRACT: It is proposed to draw the Devonian/Silurian boundary between Daling formation and Fancheng group, i.e., boundary *Monograptus uniformis*/*Pristiograptus transgrediens*.

Boundary Yingtangian/Sipaian Stage (*Xenospirifer fongi*/*Euryspirifer paradoxus shujiapingensis*) at Dale section may be identified with the Eifelian/Emsian Stage boundary based mainly on the study of brachiopods. Research carried out recently proves that *Xenospirifer fongi*/*Euryspirifer paradoxus shujiapingensis* boundary is just between *Nowakia sulcata* and *Nowakia richteri* zones.

[Continuation of BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN No 1, Mar 79 pp 99-117]

Conodonts and Tentaculites associating in the Devonian of Nayi, (Lengzhuo district reveal new correlations. Nabiao/Tangding (*Nowakia cancellata*/*Nowakia barrandei*) boundary, commonly identified with the Eifelian/Emsian Stage boundary, is much older, in fact close to the Upper/Lower Emsian boundary.

Seventeen Conodont zones of Guangxi listed in the table may be well correlated to those of Europe, North America and Australia, while the Tentaculites zones may be well correlated to Bohemia (except *Nowakia* precursor zone).

AUTHOR: HOU Renzhi [0186 0088 0037]

ORG: Department of Geography

TITLE: "The Theory and Application of Historical Geography"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARIUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 1, Mar 79 pp 119-124

TEXT OF ENGLISH ABSTRACT: This treatise deals with studies in the trend of development of modern geography. It elaborates, on the basis of the article "My Views on Historical Geography" published in an earlier issue of this journal, the role played by research in historical geography in the overall advance of the science of geography. It points out in particular that research in this field should no longer be overlooked and that it should be given priority as one of the basic theoretical questions in modern geography.

Secondly, the writer, in consideration of the conditions of the institute where he works and the facilities available to him, proposes wider and deeper studies on two subjects: (1) the district of Beijing be taken as a base or "laboratory" for thorough study in historical geography with stress laid on the changes in the natural environments in differing historical periods; (2) in view of the needs of the present production and construction projects of the nation,

[Continuation of BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN No 1, Mar 79 pp 119-124]

Historical geographical investigations be carried on in the desert region of northwest China, probing into the question of desertification in various historical periods. This, in fact, is also the field that enjoys bustling activities of geographical research elsewhere in the world.

The article especially emphasizes the importance of making use of modern scientific and technological means in research work in historical geography.

AUTHOR: SUN Zonglu [1327 1350 7627]

ORG: None

TITLE: "Treatment of Ureteral Stones by the Combination of Modern and Traditional Medicine--Report of Nine Cases by 'All-Round-Attack' Method"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTIARUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 1, Mar 79 pp 125-127

TEXT OR ENGLISH ABSTRACT: Nine cases of ureteral stones were collected within a period of seven months in the hospital of Beijing University, and were treated with the combination of modern and traditional medicine, the so-called "all-round-attack" method. The treatment was applied twice a week individually, consisting of a water intake of about 1500 cc given intermittently within an hour, an oral dose of Dihydrochlorothiazide 50 mg and 200 cc of water extract from traditional drugs at the beginning, an intramuscular injection of atropine 1 mg afterwards, and finally electric acupuncture for 25 minutes. The ureteral stones in all these cases were expelled. The duration required varied from 1-77 days, and in most cases within 18 days.

AUTHOR: SHEN Xiechang [3088 3610 2490]
LOU Yuanren [1236 0337 0088]

ORG: both of the Department of Mathematics

TITLE: "The Best Approximation by Rational Functions in Space E_p ($p > 1$) of the Complex Plane"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 2, 1979 pp 1-18

TEXT OF ENGLISH ABSTRACT: So far there have been some papers concerning the approximation by polynomials in the domain of the complex plane with E_p norm. We shall consider in this paper the approximation by rational functions with preassigned poles in the space E_p of the complex plane. In our previous paper we obtained some results concerning this problem only on the unit circle. Here we are going to generalize our results to the domain of a more general type. If the approximated function is supposed to be continuous, there is no requirement for the distribution of the poles of rational functions. When the approximated function has derivatives, in order to obtain a higher degree of approximation, we have to require the same condition on the distribution of poles. We obtained the converse theorem in the general domain also.

AUTHOR: QIAN Mingping [6929 2404 1627]
GONG Guanglu [7895 0342 7627]
QIAN Min [6929 2404]

ORG: All of the Department of Mathematics

TITLE: "The Reversibility of the Minimal Markov Process Generated by a Second Order Differential Operator"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 2, 1979 pp 19-45

TEXT OF ENGLISH ABSTRACT: In this article, we construct the minimal Markov process generated by the second order differential operator Ω :

$$\Omega u = (a(x)u')' + b(x)u' + c(x)$$

$$(a(x) \geq 0, a(x), b(x) \in C_1, c(x) \leq 0, c(x) \in C)$$

and prove that the transition function of this process has a density. The necessary and sufficient conditions of the conservation of the minimal Markov process and the necessary and sufficient conditions of the reversibility of this process are given.

AUTHOR: QIAN Min [6929 2404]

ORG: Department of Mathematics

TITLE: "The Invariant Measure and Ergodic Property of a Markov Semi-Group"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARIUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 2, 1979 pp 46-59

TEXT OF ENGLISH ABSTRACT: A Markov semi-group was constructed in a previous paper, and the existence of its semi-invariant measure was established. We now prove that the semi-invariant measure is strictly invariant and, as a consequence, the following ergodic property is proved in the weak sense:

$$\int_E p(t, x, dy) \varphi(x) dx \rightarrow \tilde{\theta}(y) \quad (t \rightarrow \infty)$$

which means convergence in probability distribution, $\tilde{\theta}(y)$ is the density of a distribution $\theta(dy)$; the initial distribution $\varphi(x)$ may be any function of L_1 .

AUTHOR: WEN Guochun [5113 0948 2797]

ORG: Department of Mathematics

TITLE: "The Existence Theorems of Continuously Differentiable and Homeomorphic Solutions for Nonlinear Elliptic Systems of First Order"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARIUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 2, 1979 pp 60-72

EXCERPT FROM ENGLISH ABSTRACT: The purpose of this paper is to prove two existence theorems of homeomorphic solutions for nonlinear elliptic systems of first order in the multiply connected domain.

AUTHOR: REN Chaozuo [0117 2600 0146]

ORG: Department of Mathematics

TITLE: "The Dirichlet Problem for a Class of Quasi-Linear Elliptic Partial Differential Equations with the Discontinuous Boundary Value"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARIUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 2, 1979 pp 73-86

EXCERPTS FROM ENGLISH ABSTRACT: In this paper we considered the Dirichlet problem for a class of quasi-linear elliptic partial differential equations

$$\Delta u(x, y) + f(x, y, u, \frac{\partial u}{\partial x}, \frac{\partial u}{\partial y}) = 0 \text{ in } D \quad (1)$$

with the discontinuous boundary value

$$u(x, y)|_{\Gamma} \bigcup_{i=1}^n P_i = \varphi(x, y) \quad (2)$$

where Γ is the boundary of the domain D , points $P_i \in \Gamma$, boundary function $\varphi(x, y)$ is of the first class of discontinuity at the points P_i .

The results obtained contain some theorems concerning existence, uniqueness and the behavior of the solution near the points of discontinuity P_i .

AUTHOR: CHEN Bin [7115 3453]

ORG: Department of Mechanics

TITLE: "Nonlinear Loss of Stability and Trembling in Gyro-Stabilization Platform"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARIUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 2, 1979 pp 87-96

TEXT OF ENGLISH ABSTRACT: This paper deals with the dangerous phenomenon of nonlinear loss of stability and "trembling" usually present in modern high precision gyro-stabilization platform designed according to linear theory. The problem is studied by using describing-function method. An illustrative example for a platform with typical parameters is given.

AUTHOR: LIAO Shantao [1675 1472 3447]

ORG: Department of Mathematics

TITLE: "An Extension of the C^1 Closing Lemma"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARIUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 3, 1979 pp 1-41

EXCERPT FROM ENGLISH ABSTRACT: The aim of this paper is to establish the following theorem:

Main Theorem. Let M^n be an n -dimensional C^∞ Riemann manifold, $n \geq 2$, over which there is given a C^1 differential system S . Let a be a nonwandering ordinary point of S . Then, for each $\epsilon > 0$, there is a C^1 differential system X on M^n which possesses a periodic orbit through a and such that $\|X-S\|_1 < \epsilon_0$.

AUTHOR: ZHAO Bolin [6392 2672 2651]
ZHANG Conglin [1728 1783 7792]

ORG: ZHAO of the Department of Geophysics; ZHANG of the Sheshan Observatory, Shanghai, Chinese Academy of Sciences

TITLE: "Ionosphere over Shanghai"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARIUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 3, 1979 pp 42-51

TEXT OF ENGLISH ABSTRACT: Ionospheric records made at Sheshan Observatory of Shanghai during March, 1953 to June, 1955, have been analyzed with the purpose of determining the values of the following ionospheric parameters: effective coefficient of recombination, intensity of the earth's magnetic field, correlation of solar activities, influence of atmospheric tides, etc. The ionospheric pulse equipment and method of ionospheric observation are also described.

AUTHOR: LIAO Shaobin [1675 4801 1755]
YIN Guangjun [1438 0342 0193]
LIU Jin [0491 6651]

ORG: All of the Department of Physics

TITLE: "Study of Microwave Dielectric Loss of Polycrystalline Ferrites"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARIUM
NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 3, 1979 pp 52-65

TEXT OF ENGLISH ABSTRACT: Through the research of microwave dielectric loss of polycrystalline ferrites of lithium system and yttrium iron garnet, we find that the directional polarization relaxation of intrinsic electric dipole and interfacial polarization relaxation are the main resources of microwave dielectric loss of the polycrystalline ferrites, and point out that the chief way of lowering the microwave dielectric loss of polycrystalline ferrites is: (1) to restrain the production of vacancies in the crystal and the entering of impurity ions of higher and lower valency into the crystal, and to prevent the occurring of high conductive phases; (2) to reduce the macroscopic or microscopic heterogeneity (e.g., pore and inclusion, etc.).

AUTHOR: ZHAO Zhiyong [6392 1807 6102]

ORG: Department of Physics

TITLE: "The Intermediate Vector Particle Model of Zweig Rule"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARIUM
NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 3, 1979 pp 66-69

TEXT OF ENGLISH ABSTRACT: We assume that the processes forbidden by the Zweig rule take place via the O particle which is a neutral vector meson, $SU(4)$ singlet and has no valence straton. Its mass, decay rates and production cross section in e^+e^- collisions are predicted. Then, with this model, we discuss some main decay modes of $T(9.5)$ and estimate T_{total} width in terms of Drell-Yan mechanism.

AUTHOR: ZHANG Rongwen [1728 2827 2773]
NI Baoling [0242 5508 7881]
HUANG Chunhui [7806 2504 6540]
YE Xueqi [5509 1331 0366]
GU Zhennan [7357 6966 0589]
MA Chongde [7456 1504 1795]
MO Zhichao [5459 1807 6389]
LIU Danyi [0491 2415 0001]
WU Zhuping [0702 4591 1627]

ORG: ZHANG, NI, HUANG, YE, GU and MA all of the Laboratory of Stable Isotopes, Department of Chemistry; MO of the Department of Geology, Beijing University; LIU of the Geology and Mineralogy Institute, Academy of Geological Sciences; WU of the Department of Chemical Engineering, Qinghua University

TITLE: "Mass Spectrometric Analysis of Isotopes in Some Natural Waters in the High Altitude Region of Mt. Jolmo Lungma"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARIUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 3, 1979 pp 70-80

TEXT OF ENGLISH ABSTRACT: Samples of glacial ice, packed snow and water collected by the Chinese climbers at high altitudes in the region north of Mt.

[Continuation of BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN No 3, 1979 pp 70-80]

Jolmo Lungma during the period from March to May, 1975, were sent to us for isotopic analysis. The absolute D contents of them were determined on a M-86 mass spectrometer, while the O-17 and O-18 contents were determined on a CH-5 mass spectrometer, both through comparison with our own reference samples. Conversion methods for preparing the inlet gases are described.

AUTHOR: XU Guangxian [1776 0342 2009]
HUANG Chunhui [7806 2504 6540]
JIN Tianzhu [6855 1131 2691]
LI Diaoguo [2621 2871 0948]

ORG: All of the Department of Chemistry

TITLE: "Separation of Pr and Nd in High Purity by Extraction with Trialkyl Methyl Ammonium Nitrate Using DTPA as Chelating Agent"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTIARUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 3, 1979 pp 81-89

TEXT OF ENGLISH ABSTRACT: The separation coefficients of Pr and Nd in ordinary extraction systems are usually less than two, so that their separation in high purity by extraction method has not been successful so far. In the so-called "pull-push" extraction, D. J. Bauer (1969) observed much higher separation coefficient for this pair of rare earths, yet the purity of Nd_2O_3 he obtained from a counter current extraction system of 20 stages was only 92 percent. In the present investigation we have obtained 99.9 percent Nd_2O_3 from the aqueous raffinate and 99.7 percent Pr_6O_{11} from the organic extract using a counter current extraction system of 10 extraction and 10 stripping stages with tri-alkyl methyl ammonium nitrate as the extracting agent in the presence of

[Continuation of BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN No 3, 1979 pp 81-89]

chelating agent diethylene-triamine-pentacetic acid.

The quaternary ammonium salt extracts Pr more effectively than Nd, while the stability of DTPA chelate is higher for Nd than Pr, so that the effective separation coefficient of this extraction system is between three and five.

AUTHOR: CHEN Peiji [7115 0012 1015]

ORG: Nanjing Institute of Geology and Paleontology, Chinese Academy of Sciences

TITLE: "An Outline of Paleogeography during the Jurassic and Cretaceous Periods of China--With a Discussion on the Origin of the Changjiang River"

SOURCE: Beijing BEIJING DAXUE XUEBAO--ZIRAN KEXUEBAN [ACTA SCIENTARIUM NATURALIUM--UNIVERSITATIS PEKINENSIS] in Chinese No 3, 1979 pp 90-109

TEXT OF ENGLISH ABSTRACT: The purpose of this paper is primarily an attempt to establish a broad outline of Jurassic and Cretaceous paleogeography of China, the knowledge of which so far remains not yet clearly known since the publication of the first "Paleogeographic Maps of China" by Professor LIU Hongyun [0491 7703 0336], 1959. This preliminary report is chiefly based upon a great number of comprehensive studies on the Mesozoic Estherid fauna together with flora and other invertebrate and vertebrate faunas and upon the subdivision and correlation of the Jurassic and Cretaceous strata.

Four sheets of paleogeographical maps (Early-Middle Jurassic, Late Jurassic, Early Cretaceous and Late Cretaceous) are given the the distribution of the land, seas, mountains, rivers and lakes during Jurassic and Cretaceous periods are briefly discussed in the Chinese text.

9717

CSO: 4009

Shipbuilding

AUTHOR: YE Yuanpei [5509 3057 1014]
SHEN Yide [3088 6318 1795]

ORG: None

TITLE: "A Systematic Study on the Performance Characteristics of Propeller Series with Slotted Nozzles"

SOURCE: Wuxi ZHONGGUO ZAOCHUAN [JOURNAL OF SHIPBUILDING OF CHINA] in Chinese Vol 65 No 2, Apr 79 pp 1-34

TEXT OF ENGLISH ABSTRACT: This paper describes and presents the results of the experiments carried out to examine the performance characteristics of propeller series working in the slotted nozzles.

After finishing some comparative tests, slotted nozzles designated JD11 and SD11 were chosed and open water tests were carried out in combination with K α -screw series of NSMB. The effects of main parameters of the slotted nozzles and propellers upon the performance characteristics are analyzed.

The results show that the slotted nozzles will effectively delay the separation

[Continuation of ZHONGGUO ZAOCHUAN Vol 65 No 2, Apr 79 pp 1-34]

of flow from the inner sides of nozzles and hence an improvement in performance is obtained as compared to that of the other ducted propeller series.

Results of this investigation are presented in the forms of K_T-K_Q-J curves, regression polynomials and $\sqrt{B_p} \sim \delta$ diagrams.

AUTHOR: DAI Yangshan [2071 0111 1472]
HE Wuzhou [6320 0063 3166]

ORG: None

TITLE: "The Prediction of Bottom Slamming"

SOURCE: Wuxi ZHONGGUO ZAOCHUAN [JOURNAL OF SHIPBUILDING OF CHINA] in Chinese
Vol 65 No 2, Apr 79 pp 35-46

TEXT OF ENGLISH ABSTRACT: Based upon the probability distribution of the relative velocity at the instant of bottom slamming without any pre-assumption of a narrow spectrum, some characteristic statistical expressions of bottom slamming pressure, such as $\bar{p}_{1/3}$, $\hat{p}_T(\alpha)$, etc., are derived and comparison is made with the predicted and measured values by M. K. Ochi.

In view of the fact that the prediction of bottom slamming load based upon the rate of change of fluid momentum was not accurate enough, a method combining the available experimental results of slamming characteristics with time-domain analysis of the ship's longitudinal motion for calculating the slamming moment of ship girder in irregular waves is developed.

AUTHOR: XUE Zhongchuan [5641 0022 1557]

ORG: None

TITLE: "The Buttock Flow and Wave-Pressing Shipform"

SOURCE: Wuxi ZHONGGUO ZAOCHUAN [JOURNAL OF SHIPBUILDING OF CHINA] in Chinese
Vol 65 No 2, Apr 79 pp 47-62

TEXT OF ENGLISH ABSTRACT: The buttock flow wave-pressing shipform was developed as a result of the research on the wave-weakening tests for the Shanghai-Chongqing Fast Passenger Cargo Ships. The basic characteristics of the shipform in question are examined based on an analysis of the relation between the shipform and resistance. This shipform has good capabilities and a promising future by virtue of its smooth flow lines, small wavemaking, low resistance and high maneuverability and stability. It satisfies the needs for inland navigation.

AUTHOR: ZHANG Shengkun [1728 5110 0981]

ORG: None

TITLE: "Elastic-Plastic Buckling Analysis of Plates and Plate-Beam Structures"

SOURCE: Wuxi ZHONGGUO ZAOCHUAN [JOURNAL OF SHIPBUILDING OF CHINA] in Chinese Vol 65 No 2, Apr 79 pp 63-81

TEXT OF ENGLISH ABSTRACT: This paper presents a layered plate subelement model for elastic-plastic bifurcation buckling of plates or plate-beam structures.

The author proposes to discretize the plate structures by non-conforming rectangle bending elements, then along the thickness of plates they are further discretized by subelements, so that the representation of three-dimensional yield surface can be reduced to two-dimensional plane elastic-plastic stress analysis.

In order to deal with plate structures, the concept of equivalent orthotropic plate is applied.

For the solution of governing eigenvalue equations, the author combined

[Continuation of ZHONGGUO ZAOCHUAN Vol 65 No 2, Apr 79 pp 63-81]

inverse-iteration method with load incremental tangent-modulus method and established λ_{imin} (the minimum eigenvalue)- p_1 (load) curve; when $\lambda_1 = 1.0$, the p_{cr} is the bifurcation buckling load.

Comparing the results of this paper with experimental results and classical solutions verifies the usefulness and accuracy of the method.

AUTHOR: TONG Zuying [4547 4371 2819]

ORG: None

TITLE: "The Design and Experimental Study of Working Circuit for Marine Limiting Torque Fluid Coupling"

SOURCE: Wuxi ZHONGGUO ZAOCHUAN [JOURNAL OF SHIPBUILDING OF CHINA] in Chinese Vol 65 No 2, Apr 79 pp 82-96

TEXT OF ENGLISH ABSTRACT: One of the basic requirements for the design of a marine fluid coupling is to improve the limiting torque characteristics at stalling, and at the same time not to impair its higher efficiency and smaller size. The geometric parameters of working circuit have a decisive influence on these characteristics of a fluid coupling. Based on the laws of flow in the working circuit and combined with the results of actual performance and model experiments of various types of fluid couplings, studying and analyzing for the influence and some design concepts to meet the marine requirements are presented in the paper. Predicted characteristics of the new type of working circuit, designed in accordance with the above recommendations, are verified by model experiments. Working circuit of this type can, therefore, be adopted by marine as well as other industrial departments in the design of fluid couplings.

AUTHOR: XU Zongmeng [1776 1350 1322]

ORG: None

TITLE: "The Fitting Method of S-L Curve"

SOURCE: Wuxi ZHONGGUO ZAOCHUAN [JOURNAL OF SHIPBUILDING OF CHINA] in Chinese Vol 65 No 2, Apr 79 pp 97-108

TEXT OF ENGLISH ABSTRACT: The paper presents a method of curve fitting. The essentials of this method are as follow:

1. Suppose datapoints A_1, \dots, A_n , and their tangent positions are known, then a polar coordinates system S_1 can be defined for optional two datapoints A_i, A_{i+1} , which suffice:

(1) The angle between $\overline{OA_i}$ and $\overline{OA_{i+1}}$ equals θ^* , which is the angle between two tangents (O is the origin point of S_1).

(2) $|\overline{OA_i}| = |\overline{OA_{i+1}}| = R_i$.

In S_1 , curve is expressed by a 3rd degree polynomial:

$$r_i(\theta) = R_i + \alpha_i \theta (\theta^* - \theta) \left(1 - 2 \frac{\theta}{\theta^*} \right)$$

2. A general formula for calculating tangent positions is derived in this paper.

For five points $A_{i-2}, A_{i-1}, A_i, A_{i+1}, A_{i+2}$ to suffice sufficient general conditions, the author proves the fact that the tangent position at point A_i lies between $A_{i-1}A_i$ and A_iA_{i+1} . Hence, the formula for calculating the angle between the tangent at point A_i and $A_{i-1}A_i$ is:

$$\Delta\beta_i = \gamma_i \frac{p_{i-1}s_i}{q_i s_{i-1} + p_{i-1}s_i}.$$

AUTHOR: XI Longfei [1598 7893 7378]
HE Guowei [0149 0948 5898]

ORG: None

TITLE: "A Study on the Song Dynasty Junk Excavated in Quanzhou Bay and Its Original Dimensions to be Restored"

SOURCE: Wuxi ZHONGGUO ZAOCHUAN [JOURNAL OF SHIPBUILDING OF CHINA] in Chinese Vol 65 No 2, Apr 79 pp 109-118

TEXT OF ENGLISH ABSTRACT: In the summer of 1974, an ancient Song Dynasty junk was excavated in Quanzhou Bay (known as Zayton Bay in ancient times), Fujian Province. This discovery is of archaeological importance, and of great value to the study of China's navigation history and the development of her shipbuilding in ancient times.

Based on this discovery, the paper describes the characteristic form and structure of the Quanzhou ship. Its low block coefficient and midship section coefficient combined with its fine lines tend to overcome the disadvantage in speed resulting from the length-breadth ratio being too small. Its gentle ribband lines make it easier to bend the outside plank, and V-shaped section

ship help to improve its seakeeping quality.

The position and the form in joining the keel are well arranged. It is remarkable that the bottom is of double plating, its side shell of triple plating, and lap joints are used alternately with butt joints. This discovery provides a substantial proof to the description of Marco Polo, the famous Italian traveler, and to the investigation made by a Japanese scholar Kuwabara. The design that the ship is divided into 11 watertight compartments is in accord with Marco Polo's record. The advanced technology in shipbuilding and the development of a rudder are also touched on in this paper.

Based on the statistic data of China's shipbuilding in the past generations combined with the existing dimensions of the very archaic vessels, the paper draws an inference from the study of its stability, strength, cargo capacity and fresh water capacity, and proposes in conclusion that the dimensions to be restored should be as follows:

length of ship	30 m
breadth	10.5 m
loaded depth	5.0 m
block coefficient	0.43
draft	1.5~1.75 m
displacement weight	199~254 tons.

9713
YSHW AMH

Shipbuilding

AUTHOR: SHI QIN [1127 0520]
GU Yunde [7357 5686 1795]
ZHONG Shizhan [6775 3719 3791]

ORG: None

TITLE: "On the Open Water Series Test of Model Tander Propeller and Its Design Method with Charts"

NUMBER: SHI: ZHONGSHI ZACHUAN [JOURNAL OF SHIPBUILDING OF CHINA] in Chinese
Vol. 66 No. 3, Aug 79 pp 1-18

TEXT OR ENGLISH ABSTRACT: This is one of a series of reports on the study of tander propeller performance. The report describes the influence of some important parameters of the tander propeller on its performance, such parameters including axial spacing ratio, angular spacing, diameter difference between fore and aft propellers, pitch distribution and pitch coordination of fore and aft propellers, blade outline and shape of blade sections, etc.

The performance charts of two sets of tander propeller (LB 4-10-2 and LB 4-10-1) are given. In addition, the block diagram for the design of tander

[Continuation of ZHONGSHI ZACHUAN Vol. 66 No. 3, Aug 79 pp 1-18]

propellers with charts using digital computer is given. According to the test results, the comparison of the tander propeller with the single conventional screw propeller at nearly the same disc ratio has shown that, under the condition of optimum diameter themselves and $\sqrt{K_T} \geq 2$, the efficiency of a tander propeller is a little higher than the conventional propeller and the optimum diameter may be decreased by more than 1 percent. However, under the condition of restricted diameter and $\sqrt{K_T} \geq 2$, the efficiency of a tander propeller is higher than of the conventional one and its increment of efficiency is increased when the Taylor's power coefficient $\sqrt{K_T}$ increased or Taylor's speed coefficient δ decreased.

AUTHOR: ZHU Chao [2612 6389]
CHEN Zeliang [7115 3419 2733]
SHI Yongshan [2457 3938 1472]
YUAN Weijin [5913 4850 6210]

ORG: None

TITLE: "The JDC 3-50 Controllable Pitch Propellers"

SOURCE: Wuxi ZHONGGUO ZAOCHUAN [JOURNAL OF SHIPBUILDING OF CHINA] in Chinese
Vol 66 No 3, Aug 79 pp 19-44

TEXT OF ENGLISH ABSTRACT: Recently a JDC three-bladed cwp series with expanded area ratio 0.35, 0.50 and 0.65 was developed in the ship model towing tank of Shanghai Jiaotong University. The open water experimental results of the JDC 3-50 series are presented in this paper. All the experimental data are analyzed by the regression method in the DJS-6 digital computer. The polynomial coefficients, open water characteristic curves, $\sqrt{B_p} \sim \delta$ diagram and the hydrodynamical spindle torque curves are given. For practical design purposes a simplified design chart and the calculated centrifugal spindle torque coefficients at the initial pitch ratios are also given.

Compared with some foreign propeller series, it shows that the open water characteristics of the JDC 3-50 series are satisfactory.

AUTHOR: WANG Xiliang [3769 6932 5428]
DING Yongshan [0002 3057 1357]
XIA Chengsheng [1115 7022 3932]
WANG Guqin [3769 2710 5367]

ORG: None

TITLE: "The Investigation of External Flow with Drag Reduction Polymer"

SOURCE: Wuxi ZHONGGUO ZAOCHUAN [JOURNAL OF SHIPBUILDING OF CHINA] in Chinese
Vol 66 No 3, Aug 79 pp 45-58

TEXT OF ENGLISH ABSTRACT: Drag reduction tests and wall concentration measurements for a 1.0 m long flat plate and a 5.463 m long body of revolution with polymer slot injection were carried out with Reynolds numbers in the range of 1.0×10^6 to 5.5×10^7 . The maximum frictional drag reductions obtained were 45 percent and 39 percent respectively.

The self-propulsion and noise measurement tests of a five-bladed screw-propeller 4.6 m long body of revolution with polymer slot injection were conducted. The results obtained show that thrust deduction fraction is slightly increased and wake fraction decreased.

AUTHOR: QIANG Guofang [1730 0948 5364]
CHEN Naixing [7115 0035 5281]

ORG: None

TITLE: "Theoretical Calculation and Experimental Investigation of the Flow Past Two-Dimensional Turbine Cascades"

SOURCE: WUXI ZHONGGUO ZAOCHUAN [JOURNAL OF SHIPBUILDING OF CHINA] in Chinese Vol 66 No 3, Aug 79 pp 79-96

TEXT OF ENGLISH ABSTRACT: In order to verify the performance of the steam and gas turbines (including exhaust turbines of the superchargers), the simplified channel method, hodograph method and electrical analog being used for surface velocity distribution calculation are presented in this paper. Viscous effects are approximately taken into account by using the boundary layer theory. The loss coefficients of the two-dimensional turbine cascades can be theoretically predicted and a figure for predicting theoretical optimum turbine cascade loss coefficients is shown.

Turbine cascades are usually of high solidities and high turning angles, so that the channel concept can be applied well. On this basis, several effective criteria have been chosen and a great number of cascade data correlated. This

[Continuation of ZHONGGUO ZAOCHUAN Vol 66 No 3, Aug 79 pp 79-96]

experimental analysis then led successfully to the establishment of some new semi-empirical formulas for predicting the loss coefficients, exit angles, optimum solidities, etc.

AUTHOR: SHENG Zhenbang [4141 2182 6721]
WANG Benli [1769 2609 4539]

ORG: None

TITLE: "Experimental Facilities of the Ship Hydrodynamics Laboratory of Shanghai Jiaotong University"

SOURCE: Wuxi ZHONGGUO ZAOHUAN [JOURNAL OF SHIPBUILDING OF CHINA] in Chinese
Vol 66 No 1, Aug 79 pp 97-109

TEXT OF ENGLISH ABSTRACT: The Ship Hydrodynamics Laboratory of the Department of Naval Architecture of Shanghai Jiaotong University has been established for 20 years. At present, the laboratory comprises two parts: ship model towing tank and cavitation tunnel. The features of these facilities are briefly introduced in this paper.

9717
C801 4020

Shipbuilding

AUTHOR: ZHOU Liandi [07 9 6647 4574]
YE Yuanpei [5509 0337 1014]
ZHENG Yongmin [6774 3057 2404]

ORG: None

TITLE: "Application of the Regression Analysis Method in Treating Experimental Data of Ducted Propeller Series in Cavitation Tunnel Tests"

SOURCE: Wuxi ZHONGGUO ZAOCHUAN [JOURNAL OF SHIPBUILDING OF CHINA] in Chinese
No 4, Oct 79 pp 1-11

TEXT OF ENGLISH ABSTRACT: In this paper, an attempt is made to apply the regression analysis method in handling the experimental data of ducted propeller series in cavitation tests. The key link in this method is to find out the exact position of onset of thrust or torque breakdown branch smoothly from that with atmosphere pressure. Applying this method and its computer program, the authors have already treated some experimental data of ducted propeller series in cavitation tests. This method may also be applied to the experimental data of open propeller in cavitation tests.

AUTHOR: TAN Zhongkai [6223 0112 2261]

ORG: None

TITLE: "On Resistance Estimate of Round Bottom Crafts by the Regression Analysis Method"

SOURCE: Wuxi ZHONGGUO ZAOCHUAN [JOURNAL OF SHIPBUILDING OF CHINA] in Chinese
No 4, Oct 79 pp 16-30

TEXT OF ENGLISH ABSTRACT: The wet surface coefficients of 122 round-bottom crafts have been analyzed in order to derive a prediction equation by the method of least-squares. The differences between the measured and the predicted coefficients are within 2.84 percent for 95 percent of the cases. In addition, the residual resistance coefficients of 87 round-bottom-type ship models have also been analyzed to derive a statistically-based correlating equation. The differences between the measured and the calculated resistance coefficients are less than 8.25 percent for 90 percent of the cases. For the sake of convenience, graphical presentation of simplified equation is given. The differences of resistance coefficients between measurements and those obtained from graphs are within 9.16 percent for 90 percent of the cases. Either the prediction equation or the graphs can be used to estimate the resistance of round-bottom craft in the range of Froude numbers: $Fn = 0.4 \sim 1.0$.

AUTHOR: LUO Huan [5012 4949 2088]
HE Hanyu [6320 0088 0001]

ORG: None

TITLE: "DD Method and Ship's Stability"

SOURCE: Wuxi ZHONGGUO ZAOCHUAN [JOURNAL OF SHIPBUILDING OF CHINA] in Chinese
No 4, Oct 79 pp 31-60

TEXT OF ENGLISH ABSTRACT: In this paper, a new method of approximate calculation and its application to the calculation of ship's stability at large angles of heel is discussed. The principle of this method is to subdivide a plan figure into small elements, each of them corresponding to a unit quantity of a certain physical property related to that figure. For the sake of convenience, a point is plotted instead of the subdivided element, such point being defined as a DD (a unit point), and the method thus is called the DD method.

Obviously, the calculation of a certain physical property, such as area of a figure, static moment and moment of inertia of that figure about a certain axis, etc., can thus be transformed into the summation of the number of the DD's settling within the boundary of the figure.

[Continuation of ZHONGGUO ZAOCHUAN No 4, Oct 79 pp 31-60]

The method to construct a DD chart is discussed, and the ordinates of the charts (the rectangular chart and the butterfly chart) have been tabulated.

In addition to the two conventional calculation procedures, a third one is suggested by means of which some of the inconvenience of the former two seems to have been prevented.

AUTHOR: YANG Cuiqiao [2799 1317 0948]

ORG: None

TITLE: "On the Tripping Stability of Tugboats"

SOURCE: Wuli ZHONGGUO ZAOCHUAN [JOURNAL OF SHIPBUILDING OF CHINA] in Chinese
No 4, Oct 79 pp 61-74

TEXT OF ENGLISH ABSTRACT: Operating conditions of both harbor and seagoing tugs were investigated. It was found that since their operating conditions are not the same, the tripping stability requirements should not be identical. In order to improve the seakeeping qualities, it is suggested that the tripping stability requirements of the seagoing tugs should be lower than those of harbor tugs. In addition to the available engine power, the effect of the displacement of the tug on its tripping speed is discussed.

AUTHOR: YU Xianhui [3713 6897 6540]
CAI Chengde [3591 2110 1795]

ORG: None

TITLE: "Ship Hull Steady Vibration Caused by Diesel Engine and Propeller"

SOURCE: Wuli ZHONGGUO ZAOCHUAN [JOURNAL OF SHIPBUILDING OF CHINA] in Chinese
No 4, Oct 79 pp 75-107

TEXT OF ENGLISH ABSTRACT: This paper introduces the calculating methods of diesel engine and propeller induced forces which often result in ship hull steady vibration. Some examples of hull vibration and effective means to reduce vibration are provided. The fracture of the tie bolts of the D19 main engine has been analyzed briefly. If the causes of vibration are considered thoughtfully during the ship design stage, many problems of ship hull vibration may be avoided or reduced.

AUTHOR: GE Yongle [5514 3057 2867]

ORG: None

TITLE: "Analytical Investigations of Three-Dimensional Temperature Distribution in Stationary Air-Cooled Blades of Marine Gas Turbine"

SOURCE: WUXI ZHONGGUO ZAOCHUAN [JOURNAL OF SHIPBUILDING OF CHINA] in Chinese No 4, Oct 79 pp 108-123

TEXT OF ENGLISH ABSTRACT: The three-dimensional temperature distribution in stationary air-cooled blades of gas turbine is theoretically treated in this paper, and a more complete calculation method is provided. The author carried out analytical investigations of temperature distribution in stationary air-cooled blades with various schemes in one of the marine gas turbines.

In conclusion, it is shown that this theoretical calculation method may also be applied to study three-dimensional temperature distribution of movable blades of marine gas turbine.

AUTHOR: GAO Huixing [7559 1920 5281]
FENG Zhonglin [1756 0112 2651]
ZOU Hongjun [6760 7703 6874]
LIANG Youdong [2733 0645 2767]

ORG: None

TITLE: "Pipe Computer Programming System PCPS"

SOURCE: WUXI ZHONGGUO ZAOCHUAN [JOURNAL OF SHIPBUILDING OF CHINA] in Chinese No 4, Oct 79 pp 124-137

TEXT OF ENGLISH ABSTRACT: The application of electronic computers to the detail design of ship piping is presented in this paper. It places emphasis on the automatic arrangements of pipe in a ship's engine-room by using dynamic programming. It mainly includes: (1) the optimum route calculation based on the input data of the positions of the pipeline terminals and other original information; (2) the determination of the location of pipelines according to the demands of actual production; and (3) the optimum processing of all pipelines so that the automatic arrangements of pipelines are fulfilled. In addition, the paper introduces the methods of interference and producibility check between pipes which were arranged manually by using non-linear programming. In conclusion, the paper schematically describes the function of automatic breaking down

[Continuation of ZHONGGUO ZAOCHUAN No 4, Oct 79 pp 124-137]

each line into pipe pieces, the function of calculating the pipe pieces and drafting various pipe diagrams. Thus, it can supply various information for pipe fabrication, installation and production administration.

PCPS has been applied to some shipyards. Since the programming of PCPS is based on the actual conditions of shipbuilding in our country, it possesses practicality and offers significant benefits.

9/17

CIO: 4020

Silicates and Ceramics

AUTHOR: CUI Fengzhu [1508 7364 2691]
ZHOU Yongzong [0719 3057 1350]
QIAO Jingwen [0829 2529 2429]
WANG Siting [3769 0934 0080]
QUAN Ningnan [2938 1380 0005]
YUAN Gang [5913 0474]
YAN Shenghui [7346 5116 6540]

ORG: All of the Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences

TITLE: "Growth of High Quality Monocrystal Sapphire by Seed-Induced Temperature Gradient Technique (STGT)"*

SOURCE: Beijing GUISUANYAN XUEBAO [JOURNAL OF THE CHINESE SILICATE SOCIETY] in Chinese Vol 8 No 2, Jun 80 pp 109-113

TEXT OF ENGLISH ABSTRACT: The various techniques for sapphire growth are summarized in this paper. It is emphasized that the melt convection in crucible has a serious effect on the quality of Czochralski crystals. In addition, the STGT of monocrystal sapphire is proposed.

[Continuation of GUISUANYAN XUEBAO Vol 8 No 2, Jun 80 pp 109-113]

The results show that the qualities of STGT crystals, such as dislocation density, optical uniformity, stress and scattering centers, etc., are better than those of the crystals grown by Verneuil and Czochralski techniques. The advantages and disadvantages of STGT for the growth of large sapphire crystals with high qualities are also discussed.

* The following made various contributions to the present study: HUANG Zhixian [7906 2535 2009], ZHU Biao [2612 3067 1795], ZHONG Yongcheng [6945 3057 2052], QIAN Zhengying [6929 2973 3391], CHEN Meixuan [7115 5019 3872], ZHENG Liansheng [6774 6667 3932], CHAI Hui [2693 6540], CHEN Guoquan [7115 0948 2938] and GU Gencai [7357 2706 2088].

AUTHOR: ZHANG Lehui [1728 2867 3055/1920]
LIU Lin [0491 3829]
BAI Jiaizhi [4101 1698 2535]
HUANG Xueli [7806 1331 3768/0448]
LIU Hairun [0491 3189 3387]

ORG: All of the Institute of Physics, Chinese Academy of Sciences

TITLE: "Estimation of Transient Growth Rate of GGG Crystals"

SOURCE: Beijing GUISUANYAN XUEBAO [JOURNAL OF THE CHINESE SILICATE SOCIETY]
in Chinese Vol 8 No 2, Jun 80 pp 114-120

TEXT OF ENGLISH ABSTRACT: The experimental procedure in the Czochralski growth of high quality GGG single crystals is described. Growth experiments related to the coupling effect of thermal and forced convection in the melt were carried out. Attention was paid to the inversion of solid-liquid interface during growth and also to the convective flow influence on crystal perfection.

In order to estimate the oscillations of transient growth rate during growth, iridium inclusions were intentionally grown into the crystal, thus the values of growth rate could be obtained by an empirical relationship between the critical growth rate V_c and the trapped particle size l , viz. $V_c = E/l^m$. Through

[Continuation of GUISUANYAN XUEBAO Vol 8 No 2, Jun 80 pp 114-120]

measurement of the linear sizes of a large amount of iridium particles, the constants of the empirical formula for growth of GGG can be found out, viz. $E = 1.5 \times 10^2$, $m = 1.08$.

* Cui Shufan [1508 2885 5400] and GE Peiwen [5514 1014 2429] took part in the study.

AUTHOR: ZHANG Shouqing [1728 4849 1987]
TANG Lianan [0781 6647 1344]
WANG Wen [3769 2429]
LE Xihong [2867 4423 1347]

ORG: All of the Shanghai Institute of Silicates, Chinese Academy of Sciences

TITLE: "The Relationship between Growth Direction and Grain Boundaries Generated in Sapphire Plate Crystals Grown by the EFG Technique"

SOURCE: Beijing GUISUANYAN XUEBAO [JOURNAL OF THE CHINESE SILICATE SOCIETY] in Chinese Vol 8 No 2, Jun 80 pp 121-124

TEXT OF ENGLISH ABSTRACT: Sapphire plate crystals 1 mm in thickness, 25 mm in width and 250 mm in length have been grown by the EFG method. Crystal imperfections were examined by means of microscopic method and X-ray Laue-topographic techniques. For the growth of sapphire plate crystals with (1102) surfaces, three growth directions have been chosen. They are $[\bar{1}101]$, $[02\bar{2}1]$ and $[11\bar{2}0]$.

It is noticed that the generation of grain boundaries is closely related to the pulling directions. In crystals grown along $[\bar{1}101]$, there commonly exist a great number of grain boundaries, while in crystals grown along $[02\bar{2}1]$ or $[11\bar{2}0]$

[Continuation of GUISUANYAN XUEBAO Vol 8 No 2, Jun 80 pp 121-124]

the grain boundaries are obviously reduced. It is believed that the (0001) $\langle 11\bar{2}0 \rangle$ slip system must be responsible for the generation of such imperfections.

The experiments clearly demonstrate that in order to obtain sapphire plates of high quality as substrate material for SOS devices, in addition to controlling the growth rate to an optimum value and selecting a seed crystal with fewer imperfections, great attention must be paid to choosing a favorable growth direction so as to eliminate the generation of grain boundaries.

AUTHOR: HOU Chunming [0100 7000 7122]

ORG: Shanghai Institute of Silicates, Chinese Academy of Sciences

TITLE: "Study of the Growth Habit of LiTaO_3 Single Crystals"

SOURCE: Beijing GUIBANYAN XUEBAO [JOURNAL OF THE CHINESE SILICATE SOCIETY]
in Chinese Vol 8 No 2, Jun 80 pp 123-129

TEXT OF ENGLISH ABSTRACT: The growth habits of LiTaO_3 , especially the distribution of growth ridges and facets on crystal surfaces, have been studied in detail. The mechanism of formation of the morphological features is discussed phenomenologically on the basis of structure model of unit cell and the appearance of these features is explained in light of structural symmetry of LiTaO_3 crystals. The calculated results of the model coincide fairly well with the experimental data obtained.

* The following contributed to the present study: ZHANG Xingnan [1728 2502 0005], ZHANG Guoxiang [1472 0948 4382], TANG Lianan [0781 6647 1344], JIN Weiqing [4855 5588 7210], LI Xishong [2867 4423 1347], LIU Shengli [0491 0524 0418], WANG Wei [3769 2429], ZHANG Guoxin [1728 0948 2450], YU Xiaofu [0151 2556 6534], LI Deyu [2621 1795 1142], ZHANG Shouqing [1728 4849 1987], GU Zujun [6253 4371 0193] and WANG Lanxi [3769 5198 1185].

AUTHOR: ZHANG Kecong [1728 0344 1783]
CHEN Jingang [7115 6855 1649]
WANG Jiyang [3769 4949 2254]
LIU Qingshun [0491 3237 5291]
WANG Xin [3769 2946]

ORG: All of the Research Institute of Crystal Materials, Shandong University

TITLE: "Growth and Perfection of Deuterated Doped Triglycine Sulfate (DATGS) Crystals"

SOURCE: Beijing GUIBANYAN XUEBAO [JOURNAL OF THE CHINESE SILICATE SOCIETY]
in Chinese Vol 8 No 2, Jun 80 pp 130-136

TEXT OF ENGLISH ABSTRACT: This article describes the experimental conditions of the growth of Deuterated Doped TGS (DATGS) crystals in D_2O solutions by slow cooling method and the different types of defects in the crystal and the rule of their distribution as investigated by optical microscopy and X-ray topography. Compared with TGS crystals, the defects existing in DATGS crystals are far more distinct and depend much upon parameters of growth. An attempt has been made to establish the relationship between the perfection of crystals and

[Continuation of GUISUANYAN XUEBAO Vol 8 No 2, Jun 80 pp 130-136]

their growth conditions in order to find out the optimum parameters for the growth of DATGS crystals so as to extend the range of their applications.

* Cui Changtai [7051 7022 1141], Department of Chemistry, Shandong University, and Wu Lianzhang [0702 0051 4545], Laboratory 4, Institute of Physics, Chinese Academy of Sciences, helped with the present study.

AUTHOR: None

ORG: Flux Growth Method Group, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences

TITLE: "Flux Growth Method for YAG:Nd Crystals and Located Nucleation Technique"

SOURCE: Beijing GUISUANYAN XUEBAO [JOURNAL OF THE CHINESE SILICATE SOCIETY] in Chinese Vol 8 No 2, Jun 80 pp 137-142

TEXT OF ENGLISH ABSTRACT: A new technique of located nucleation by water-cooling used in the flux growth of YAG:Nd crystals is described with optimum melt composition and cooling program given therein. The nucleated numbers have been controlled successfully and fairly good quality crystals of 200-400 g by weight have been produced steadily.

* The following contributed to this study: ZHANG Shanshan [1728 3790 3790], TIAN Wanchun [3944 8001 2504], ZHONG Heyu [6945 7729 5940], PAN Shoukui [3382 1343 5688], JIANG Shubin [1203 2885 2430], DENG Peizhen [6772 0160 3791], YUAN Gang [5913 0474], WANG Renshu [3769 0086 3219], WU Lianzeng [0702 6647 1073], ZHUO Dunshui [0587 2415 3055], YU Wenfu [6735 2429 1381] and WANG Jiliang [3769 4764 5328].

AUTHOR: QIAN Zhongyue [0029 2182 5101]
HOU Yinchun [0186 0801 2506]
DENG Peizhen [6772 0160 3791]

ORG: All of the Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences

TITLE: "A Study of the Quality of Sapphire by X-ray Diffraction Topography"

SOURCE: Beijing QIJIANYAN XUEBAO [JOURNAL OF THE CHINESE SILICATE SOCIETY] in Chinese Vol 8 No 2, Jun 80 pp 143-146

TEXT OF ENGLISH ABSTRACT: X-ray diffraction topographies have been employed in the study of defects in sapphire single crystal grown by Verneuil, Czochralski, Edge-Defined Film-Fet Growth (EFG) and Temperature Gradient Growth (TGG) techniques. In TGG crystals the triangular-cross-grid dislocation lines have been noticed and the Burger's vectors thereof determined.

* QIAO Jingwen [0029 2529 3429] and GU Shenghui [7357 5116 6540] provided assistance.

AUTHOR: CHEN Xianqiu [7115 7359 3061]
LI Jiaohi [2621 1367 3112]
HUANG Ruifu [7806 3843 4395]

ORG: All of the Shanghai Institute of Silicates, Chinese Academy of Sciences

TITLE: "The Microstructure of Ge(ko) Type and Celadon Type Sherds Excavated from the Great Capital of the Yuan Dynasty"

SOURCE: Beijing QIJIANYAN XUEBAO [JOURNAL OF THE CHINESE SILICATE SOCIETY] in Chinese Vol 8 No 2, Jun 80 pp 147-158

TEXT OF ENGLISH ABSTRACT: The microstructure of Ge(ko) type and celadon type sherds, which were excavated from the great capital of the Yuan dynasty, were studied by means of polarizing microscopy, electron microscopy and scanning electron microscopy. The results assured that the glazes of Ge-type sherds are of crystalline nature with long prismatic plagioclase crystallites. These glazes have an opalescent appearance and crackled mainly because of the plagioclase crystallization. The Ge-type and celadon type glazes are almost the same in chemical composition, only the CaO content in the celadon type glazes is higher. However, from the results of physical chemical analysis it can be shown that the compositions of these two glazes are within different primary crystalline

regions in $\text{CaO-Al}_2\text{O}_3\text{-SiO}_2$ phase diagram. The microstructure of celadon glazes has the properties of the nature of glass and an appearance belonging to a peculiar style. It has been found that there are many scattering particles between the plagioclase crystallines in the Ge-type glazes. The experimental results prove that these particles are submicroscopic pores with diameters of less than 2000 Å. By examining in detail the microstructures of the porcelain bodies of the excavated sherds, the different raw materials from which they were made have been identified.

* Also taking part were: JIANG Lingzhang [1203 6845 4545], CHEN Shiping [7115 1102 5493], GU Zujun [6253 4371 0193], CHEN Peiqi [7115 0160 3825], RUAN Meiling [7086 5019 3781] and SHAO Kangqing [6730 1660 3237]. Providing assistance were: DING Yizhong [0002 5030 1813], Institute of Archeology, Chinese Academy of Social Sciences, and WANG Qingzheng [3076 1987 2973], Shanghai Museum.

AUTHOR: HOU Lisong [0186 4539 2646]
TANG Yanru [0781 1750 5423]
ZHU Yuxiu [2612 3022 4423]

ORG: All of the Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences

TITLE: "An Investigation on the Chemical Durability of Nd-Doped Phosphate Glasses"

SOURCE: Beijing GUISUANYAN XUEBAO [JOURNAL OF THE CHINESE SILICATE SOCIETY] in Chinese Vol 8 No 2, Jun 80 pp 159-170

TEXT OF ENGLISH ABSTRACT: A new test method has been developed to determine the chemical durability of Nd-doped phosphate glasses of $\text{P}_2\text{O}_5\text{-BaO}$, $\text{P}_2\text{O}_5\text{-Al}_2\text{O}_3\text{-BaO}$, and $\text{P}_2\text{O}_5\text{-Al}_2\text{O}_3\text{-Li}_2\text{O-BaO}$ systems in water. The effects of eight metallic oxide substitutes for BaO on the water resistance were investigated. The results obtained were discussed in light of glass structure and the polarization ability of the cations in glass. On the basis of the mechanism of glass corrosion, it was pointed out that the corrosion rate might be accelerated in some of the glasses tested.

* JIANG Zhonghong [1203 0022 1347] provided assistance.

AUTHOR: None

ORG: The Radioisotope Analyser Group for Ca and Fe, Cement Research Division, Research Institute of Building Materials

TITLE: "The Radioisotope Analyser for Ca- and Fe- Determination of Cement Raw Meal"

SOURCE: Beijing GUI SUANYAN XUEBAO [JOURNAL OF THE CHINESE SILICATE SOCIETY] in Chinese Vol 8 No 2, Jun 80 pp 171-179

TEXT OF ENGLISH ABSTRACT: Two types of radioisotope X-ray fluorescence analysers for Ca- and Fe- determination of cement meal have been made. For the determination of CaO content, a $^3\text{H-Ti}$ radioisotope source has been adopted in both types. By proper choice of the upper limit of the window of the pulse-height analyser, the interference of FeKX can be effectively eliminated. For the determination of Fe_2O_3 content, a $^3\text{H-Ti}$ radioisotope source is adopted in one type, a $^3\text{H-Zr}$ source in the other. By using a compensation filter, both the interference of CaKX and the matrix absorption effect of Ca atoms are effectively eliminated. The analytical results of CaO and Fe_2O_3 are in good agreement with X-ray fluorescence spectrometry.

The structures of the two analysers and their performances in two of the cement plants have also been described briefly.

AUTHOR: ZHANG Qingchun [1728 3237 4783]

ORG: Shanghai Institute of Silicates, Chinese Academy of Sciences

TITLE: "Fracture of Ceramics"

SOURCE: Beijing GUI SUANYAN XUEBAO [JOURNAL OF THE CHINESE SILICATE SOCIETY] in Chinese Vol 8 No 2, Jun 80 pp 180-193

TEXT OF ENGLISH ABSTRACT: On the basis of fracture mechanics, the catastrophic rapid propagation of cracks in terms of stress concentration and energy balance conditions and the slow crack propagation in terms of stress corrosion or other mechanisms have been described. This concept has already found practical application in the study of the conditions of crack propagations, both slow and fast, on quantitative basis and as functions of composition, structure, temperature and chemical environment.

Fracture studies are dealt with both in the light of crack initiation in some of the materials and plastic effects at crack tips. This paper is an attempt to provide from the state of the art of knowledge of fractures a rational and quantitative interpretation of crack behavior of brittle ceramics. Stress has been laid both on the fundamental concepts and on some of the most important illustrations with the hope of helping development of research on polycrystalline ceramics.

AUTHOR: None

ORG: Institute of Geology of Geological Company, Ministry of Building Materials Industry

TITLE: "Serpentine Asbestos of Lushi County of Henan Province and Guangji County of Hubei Province"

SOURCE: Beijing GUISUANYAN XUEBAO [JOURNAL OF THE CHINESE SILICATE SOCIETY] in Chinese Vol 8 No 2, Jun 80 pp 194-200

TEXT OF ENGLISH ABSTRACT: The mineralogy of well-crystallized serpentine asbestos occurring in metamorphic dolomitic rocks has been studied, and electron micrographs, electron diffractions, X-ray analyses, IR, thermal analyses, chemical analyses together with the physical properties of the species are presented.

* YANG Yaxiu [2799 7161 4423] is the author of this article; the following provided assistance: SHU Xiuqin [2631 4423 3830], HUANG Bojun [7806 0130 6874], YU Zhong [0060 5883], LI Youqin [2621 1635 3830], XIONG Buhe [3574 2975 0735] and ZHENG Xiu [6774 4423].

AUTHOR: ZHANG Yuchun [1728 3768 2504]
XIE Chunbo [6200 2404 3134]
WANG Qianjin [3769 0467 6651]
ZHANG Xiqiu [1728 6932 4428]

ORG: ZHANG Yuchun, XIE and WANG all of the Ceramic Research Institute, Tangshan Ceramic Company; ZHANG Xiqiu of the Ministry of Light Industry

TITLE: "A New Technique of Pottery Decoration--In-Glaze Color"

SOURCE: Beijing GUISUANYAN XUEBAO [JOURNAL OF THE CHINESE SILICATE SOCIETY] in Chinese Vol 8 No 2, Jun 80 pp 201-205

TEXT OF ENGLISH ABSTRACT: The in-glaze colors were obtained by using the on-glaze technique in a specific quick-firing kiln with a temperature of 1100~1250°C. It is proved that this kind of glaze has the properties of good mechanical abrasion resistance and minor lead release in addition to its striking colors. Eighteen kinds of in-glaze colors mentioned in this article have been put into batch production.

**END OF
FICHE
DATE FILMED**

August 27 1980